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Anthrenus (*Nathrenus*) *jakli* sp. n. (Coleoptera: Dermestidae) from the Sultanate of Oman, and distributional notes on some other *Anthrenus* species

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Abstract. *Anthrenus* (*Nathrenus*) *jakli* sp. n. (Sultanate of Oman) is described and illustrated. New records extending the known geographic distribution of the following species are published: *Anthrenus* (*Nathrenus*) *albomaculatus* Pic, 1927 (Malaysia); *A.* (*N.*) *subsetosus* Arrow, 1915 (Vietnam); *A.* (*Anthrenodes*) *maculifer* Reitter, 1881 (Thailand, Borneo).

Taxonomy, new species, distribution, Coleoptera, Dermestidae, *Anthrenus*, Arabian peninsula, Oriental region

The following abbreviation are used in the text:
JHAC – coll. Jiří Háva, Praha, Czech Republic;
JHOC – coll. Jan Horák, Praha, Czech Republic;
NMPC – coll. National Muzeum, Praha, Czech Republic (J. Jelínek);
RCEC – coll. Radek Cervenka, Praha, Czech Republic;
SJAC – coll. Stanislav Jakl, Praha, Czech Republic;
SMNS – coll. Staatliches Museum für Naturkunde, Stuttgart, Germany (W. Schawaller).

Anthrenus (*Nathrenus*) *albomaculatus* Pic, 1927

MATERIAL EXAMINED. Malaysia, W Perak, 25 km NE of Ipoh, 2100m, Banjaran Titi Wanga mts., Korbu mt., 4–13.iii.1998, P. Pacholátko lgt., 1 spec., J. Háva det., JHAC.

DISTRIBUTION. Species known so far only from Borneo (Mroczkowski, 1968). New for the fauna of the continental Malaysia.

Anthrenus (*Nathrenus*) *jakli* sp. n.

(Figs 1–2)

TYPE MATERIAL. **Holotype** (male): Oman mer., rd. Al Mughsayl – Salalah, ca. 3km from Al Mughsayl, 20m, 8–11.viii.1999, S. Jakl & R. Červenka lgt. **Paratypes**: 21 specimens the same data as holotype. Holotype deposited in NMPC, paratypes in JHAC, RCEC, SJAC, SMNS.

DESCRIPTION. Male. Length 2.3–2.6 mm, width across humeri 1.4–1.7 mm. Scales black, brown-yellow, yellow and white in dorsal and ventral surfaces. Scales of dorsal surfaces forming paterns; one large fascia on anterior part, one large and two small paterns on middle; one large fascia on posterior part and one apical patern; all paterns forming with brown-yellow and white scales. Scales in ventral surfaces entirely white intermixed yellow scales and with patern of brown-yellow scales. Individual scales widest about middle with sides converging to strongly rounding apex. Head with yellow scales with small patch of white scales nearly eyes. Antennae black with

11-segmented; antennal club 3-segmented (Fig. 1). Eye with median margin entire. Lateral margins on pronotum distinctly dilated above antennal fossa and visible from above. Lateral sides about 2/3 to apex on elytron brown-yellow. Abdominal sterna 2–5 with small patch of brown-yellow scales at antero-lateral margins. Prosternum with only white scales. Metasternum with white scales, and with one small patch of brown-yellow scales at lateral margins. Legs brown with white scales and yellow setae. Aedeagus in (Fig. 2).

Female similar to the male.

DIFFERENTIAL DIAGNOSIS. *Anthrenus* (*Nathrenus*) *jakli* sp. n. very similar species *A*. (*N*.) *transcaspicus* Mroczkowski, 1960 described from Turkmenia and N Iran. Differs from of form of body, antennae, scales and genitalia.

DISTRIBUTION. Sultanate of Oman

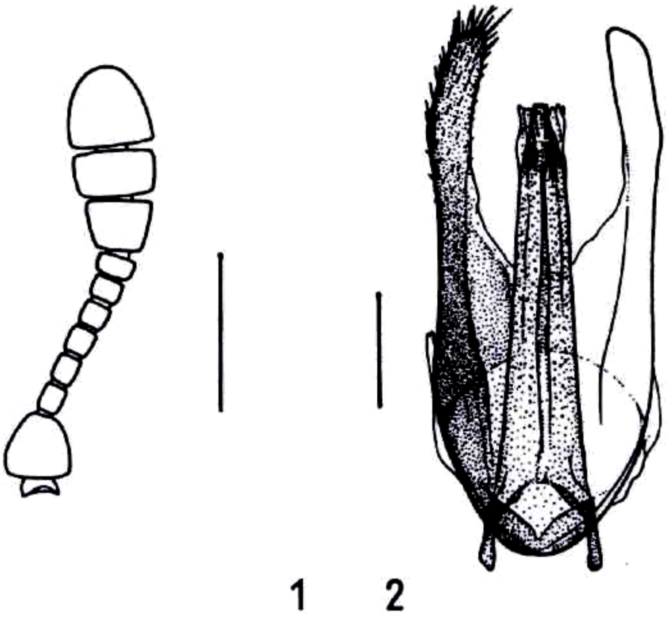
NAME DERIVATION. Dedicated to the collector of the new species Stanislav Jakl (Praha, Czech Republic).

BIOLOGY. Adults were collected on flowers of Asteraceae gen. sp.

***Anthrenus* (*Nathrenus*) *subsetosus* Arrow, 1915**

MATERIAL EXAMINED. N Vietnam, Tam Dao, Vinh Phu distr., 900m, 17–21.v.1990, J. Horák lgt., 3 spec., J. Háva det., JHAC, JHOC.

DISTRIBUTION. Species known so far only from Burma [Myanmar] (Mroczkowski 1968). New for the fauna of Vietnam.



Figs 1–2. *Anthrenus* (*Nathrenus*) *jakli* sp. n. 1 – antenna; 2 – aedeagus (scales = 0.1 mm).

Anthrenus (*Anthrenodes*) *maculifer* Reitter, 1881

Anthrenus globiger Arrow, 1915: 447.
Anthrenus multimaculatus Pic, 1918: 2.
Anthrenus albonotatus Pic, 1922: 6.

MATERIAL EXAMINED. NW Thailand, Chiang Mai distr., Doi – Pui vill., 1600m, 2–6.v.1996, J. Horák lgt., 1 spec J. Háva det., JHAC; NW Thailand, Mae Hong Son distr., Soppong env., 600m, 28.v.1999, D. Hauck lgt., 1 spec J. Háva det., JHAC; NW Thailand, Mae Hong Son distr., Soppong, 1500m, 9–12.v.1996, S. Bílý lgt., 5 spec J. Háva det., JHAC, NMPC; NE Thailand, Loei prov., Phu Kradung NP, 1300m, 11–15.v.1999, M. Řiha lgt 9 spec., J. Háva det., JHAC; Thailand, Soppong Pai, 1800 m, 1–8.v.1998, P. Pacholátko & L. Dembický lgt 88 ex, J. Háva det., JHAC; Borneo, W Sabah, Crocker Range, E., W of Apin Apin, v.1999, M. Snížek lgt., 1 spec J. Háva det., JHAC.

DISTRIBUTION. Species known so far from India, Taiwan, Vietnam, Burma [Myanmar], and China (Mroczkowski 1968, Vijay Veer 1995). New for the fauna of Thailand and Borneo.

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I am very indebled to my colleague Stanislav Jakl (Praha), Radek Červenka (Praha), Jan Horák (Praha), Svatopluk Bílý (Praha), Petr Pacholátko (Brno), David Hauck (Brno), Martin Řiha (Brno); Miroslav Snížek (České Budějovice) for the loan of the interested material. Many thanks are to Zbyněk Kejval (Domažlice) for the drawing of the figures of the new species and David Král (Charles University Praha) for valuable comments on the manuscript.

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BOOK REVIEW

GARCIA LYNNE S.: **Practical Guide to Diagnostic Parasitology**. Washington, D. C., American Society for Microbiology, 1999. XVIII+349 pages. Format 177×252 mm. Soft cover. Price USD 49.95. ISBN 1-55581-154-X

The author is manager of department of pathology and laboratory medicine at the UCLA Medical Center in Los Angeles, California. As she emphasizes in the preface, during the past few years the field of diagnostic medical parasitology has continued to see some dramatic changes, counting in newly recognized pathogens, new methodology and regulatory requirements that have impact on diagnostic testing relevant to patient care.

The volume is composed of eight sections divided into chapters and subchapters. **Section 1** introduces the **Philosophy and Approach to Diagnostic Parasitology** for testing persons exposed to the risk of infection because of travelling, for control issues and epidemiologic considerations, for examining compromised patients or for therapy. Next considerations deal with laboratory personnel, laboratory setting and equipment, the selection and costs of procedures, and more. **Section 2** centres attention upon **Parasite Classification and Relevant Body Sites** while surveying characteristics of intestinal, blood and tissue-dwelling protozoa, intestinal, tissue and blood nematodes, cestodes and trematodes enclosing pentastomids and thorny-headed worms Acanthocephala. **Section 3** constitutes a highlight of **Collection Options**: collection and examination of fresh and preserved stool specimens, of blood and various organ specimens. Among others included are instructions on preparation of compound fixatives – sodium acetate-acetic acid-formalin (SAF), Schaudinn's fluid and modified fixatives with polyvinyl alcohol (PVA). **Section 4** is devoted to **Specimen Test Options: Diagnostic Methods and Body Sites** – covered here are diagnostic procedures for stool specimens enclosing culture of larval-stage nematodes, estimation of worm burdens through egg counts, hatching test for schistosome eggs, screening stool samples for recovery of tapeworm scolex, examination for pinworms, testing of sigmoidoscopy and duodenal drainage material, and duodenal capsule technique (entero-test). Subsequent chapters are concerned with urogenital tract specimens, with sputum, aspirates, biopsy specimens and blood. In conclusion, culture methods, animal inoculation and xenodiagnosis, antigen and antibody detection are looked at. **Section 5** – **Special Test Procedures and Algorithms** – presents one third of the page extents of this volume. Described are calibration of the microscope and diverse examinations of faeces, enclosing detailed procedures of sedimentation and flotation concentrations, and staining. In subsequent chapters described are various procedural techniques for identification of larval nematodes and tests for examination of gastrointestinal and urogenital tracts specimens, examination of blood smears, and blood concentration methods: buffy coat concentration, Knott concentration, membrane filtration). The algorithms are presented here in form of seven flow diagrams incorporating highlight of particular tests, clinical conditions and parasite species. Finally outlined are body sites, specimen, and recommended stains. **Section 6** – **Commonly Asked Questions about Diagnostic Parasitology** – encompasses specimens collection and processing, diagnostic methods, organism identification, reporting, and proficiency testing. **Section 7** is concerned with **Parasite Identification** while exploring individual parasite species with respect to general morphological description, to clinical correlations, and to basic procedural techniques for diagnosis. Textual part of this section is profusely augmented by figures and photographs of trophozoites, cysts, spores, blood and tissue forms of protozoans, and eggs of human helminths, larval stages of nematodes, proglottids of tapeworms, including protoscolices of *Echinococcus granulosus*. **Section 8** provides comprehensive **Identification Aids** in the form of 35 summary-type tables. Introductory two tables make a survey of diagnostic characteristics for parasites in wet mounts and permanent wet smears. Subsequent 13 tables take a look at morphology of intestinal protozoa. Subsequent 11 tables provide coverage of helminths. Other tables summarize malarial plasmodia, feature human leishmanial infections, and African and American trypanosomiases. Concluding tables contain key characteristics of protozoan parasites and helminths, and some rapid diagnostic procedures.

This publication presents one of few modern handbooks for laboratory diagnostics of parasitic infections or diseases. Incorporated are all pieces of recent knowledge on protozoans and helminths relating to the intestinal coccidia, microsporidia, species array of leishmaniae and amphizoic amoebae, tissue nematodes, lung trematodes and some other parasitic organisms. The textual part is illustrated by a wealth of line drawings and microphotographs. Moreover, there are numerous original tabular reviews numbered within the structural frame of particular chapters, and besides – not numbered ones. Graduate students and professionals working in diverse fields of parasitology and microbiology will find this book to be a conceptionally unique manual for laboratory work.

Jindřich Jíra

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Oribatid mites (Acari: Oribatida) on reclaimed and unreclaimed wasteland near Chvaletice (Czech Republic)

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Abstract. Abandoned pyrite processing sedimentation ponds were studied: (1) Mite communities were compared at various stages of plant succession on reclaimed and unreclaimed parts of the area, respectively. (2) Mite communities were sampled on four plots in the unreclaimed area. The heterogeneity between plots during a year, the tendencies to aggregate were recorded. (1) Oribatids were the most dominant mite group: 37 species were found. The reclaimed area had more species. *Tectocepheus velatus* (Michael, 1880) Oppiidae species, *Ceratozetes mediocris* Berlese, 1908 and *Galumna lanceata* Oudemans, 1990 were dominant in both the reclaimed and the unreclaimed plots, although more abundant in the reclaimed plots. The unreclaimed plots were inhabited by poorer communities, which were strongly influenced by the vegetational cover. (2) No mite community was present in the plot without vegetation. The plot covered with the moss hosted a poor and unstable community of Oppiidae and *Tectocepheus velatus*. In contrast, plots overgrown by grass or birch forest were inhabited by abundant *Tectocepheus velatus* and Oppiidae. *Tectocepheus velatus* was most abundant in the grass covered plot and Oppiidae in those covered with birch forest. *Ceratozetes mediocris* and *Galumna lanceata* only formed stable populations in the birch forest. Trends in aggregation were correlated with abundance but differed between species. The burning of vegetation combined with high summer temperatures probably were the most important factors causing oribatid abundance to decline. After the fire oribatid mites were not aggregated, but dispersed randomly, and then a rapid growth in the mite population (Oppiidae and *Tectocepheus velatus*) occurred.

Ecology, wasteland, reclaimed soil, non-reclaimed soil, toxic substratum, succession, Acari, Oribatida, Bohemia

INTRODUCTION

Fields and abandoned industrial waste are artificial biotopes strongly influenced by human activities, characterised by temporal absence of vegetation – wastelands initially that are gradually colonized by plants and animals. Restoration is a human effort, which aims to facilitate colonization. On unreclaimed wastelands spontaneous plant succession occurs slowly compared to that on reclaimed areas. Litter is colonised by micro-organisms and both serve as food source for oribatid mites (see Hartenstein 1962, Luxton 1972). On the other hand, oribatids positively influence litter decomposition (as review Seastedt 1984).

The nature of the oribatid communities could indicate quality of the environment (Hartnig-Kümmel 1984, Weigmann 1991). Wasteland biotopes are characterised by few species and a low abundance of oribatid mites (Beckmann 1988, Skubala 1995). Among the mite colonists of wastelands are the ubiquitous mites like *Tectocepheus velatus* and some Oppiidae species. Their populations fluctuate in these biotopes: seasonal fluctuations are probably associated with seasonal changes in the environment, especially in precipitation and litter input (Luxton 1981c). They also fluctuate in terms their spatial distribution (Smrž & Jungová 1987), which could be correlated with microclimate and food sources (Mitchell 1978).

The aim of this study was (1) to describe the mite communities on two different areas (reclaimed and unreclaimed) characterised by different vegetation, (2) to record the differences between the four unreclaimed plots with different vegetation, the seasonal changes in the mite communities in each plot and the heterogeneity between samples taken at the same time from a plot.

STUDY AREA

The study area was situated 5 km north-east of Chvaletice town (near Pardubice), about 179 m a. s. l., in square No. 5958 of the reference grid map (Pruner & Mika 1996). The wasteland consisted of two parts both on sandy alluvia of Labe river: (1) a non-reclaimed flat area of ca 8 ha, (2) reclaimed artificial mound ca 50 m high and ca 400 m long.

The wasteland consisted of waste from pyrite processing. The original material was crushed, the waste separated and deposited in sedimentation ponds. The waste was rich in sulphur and phenols and had a pH of about 3. The sedimentation ponds were abandoned, part of the waste was piled up in a mound and reclaimed by covering with soil (Kovář 1979). Grass and shrubs were growing on the mound at the time of study (Kovář 1994). The sedimentation ponds were allowed to dry out and the acidity of substratum changed (pH increased to 5.5–6.5) by watering the upper layers. As a result some vegetation became established there by spontaneous succession and remained stable for 15 years with small fluctuations (Kovář 1994).

The area was surrounded by the following biotopes: birch (*Betula pendula*) forest, fields, and grass and trees growing on the bank of the Labe river.

The study plots were rectangles of ca 1.8×0.9 m, each covered with a distinct vegetation established by spontaneous succession. The vegetation was described by Kovář (1994). Plots Nr. 1–7 were situated on the non-reclaimed area, and the plots Nr. 8–11 were on the reclaimed mound.

Plot Nr. 1 had a dark substratum without vegetation, and was partly covered with a salt crust. Some patches of vegetation (e.g. on plot Nr. 5) made up of grass and moss, occurred around this plot. Plot Nr. 2 was covered with moss (*Ceratodon purpureus*). In the neighbourhood of this plot (at a distance of ca 10 m) occurred the following two plots, Nr. 3 and 4. Plot Nr. 3 was overgrown with grass (*Calamagrostis epigeios*), lichen (*Cladonia coniocraca*) and small solitary birches (*Betula pendula*). A fire damaged the vegetation on this plot in August 1994. Plot Nr. 4 was covered with young birch (*Betula pendula*), trees two or three meters high, with a herb layer of patches of short grass. Litter and the above-ground parts of the herbaceous plants were burnt in August 1994. Plot Nr. 5 was small vegetation patch (area about 1 m^2) near to plot Nr. 1. The vegetation consisted of moss (*Ceratodon purpureus*) and grass (*Calamagrostis epigeios*). Plot Nr. 6 part of the substratum was flooded, generally overgrown with the reed (*Phragmites communis*) and close to a temporary pond of about 250 m^2. Plot Nr. 7 was situated under a willow (*Salix* sp.). growing at the margin of the birch forest (plot Nr. 4). There was little litter side on this plot. Plot Nr. 8 was on the southern side of the mound. The dominant plants were: *Arrhenatherum elatius, Senecio viscosus, Sisymbrium loeseli*. Plot Nr. 9 was on the eastern side of the mound. The dominant plants were: *Festuca rubra, Achillea milefolium, Agropyron repens, Cirsium arvense*. Plot Nr. 10 was on the western side of the mound. The dominant plants were: *Festuca rubra, Arrhenatherum elatius, Betonica officinalis*. Plot Nr. 11 was on the northern side of the mound. The dominant plants were: *Vicia craca, Agropyron repens, Cirsium arvense, Calamagrostis epigeios, Chamaenerion anguistifolium*.

METHODS

The mite communities inhabiting the unreclaimed and the reclaimed sites were compared. All plots were monitored in September 1996. Three (plots Nr. 5–11) or five (plots Nr. 1–4) soil samples (each 400 cm^3) were taken from each plot, using a stainless-steel cylindrical corer.

The plots Nr. 1–4 on the unreclaimed site were studied from November 1993 to November 1994 (climatic conditions see Fig. 1). Twelve soil samples (each 100 cm^3) were taken monthly from every plot giving a total of 576 samples from all the plots. The samples in each plot were taken along three lines, 45 cm distant from each other, with four equally spaced samples in taken along each line giving a rectangle of 4×3 samples.

Mites were extracted in Berlese-Tullgren funnels (35 °C for 7 days) and fixed in 80% ethyl alcohol. Oribatids were determined to species, expect families Brachychthoniidae, Oppiidae, Suctobelbidae and genus *Phthiracarus*, which were included in the synecological calculations as a genera. Juveniles were not included in the analysis.

Numbers of individuals (N) and species (S), frequency in samples (F), diversity index (H) as the Shannon-Wiener function ($H=Sp_i\log_2p_i$, when p_i is dominance of i-species, see Krebs 1981) were calculated for each sample and presented in the form of mean or median with interquartile range from for each plot (Nr.1–Nr.4). The samples without any mites had $H=0$ and $S=0$.

RESULTS

Oribatids were the most dominant mite group; 20 oribatid species and 3 undetermined taxa in 2 227 individuals were collected (Tab. 1) on plots Nr. 1–11 in September 1996. More species and specimens were observed in the reclaimed plots. While the most abundant species (*Tectocepheus velatus*, *Ceratozetes mediocris* and *Galumna lanceata*) and Oppiidae occurred in both the reclaimed and the unreclaimed plots. The less common species (*Scheloribates laevigatus*, *Ctenobelba pectinigera*, *Liacarus coracinus* – the others see Tab. 1) only occurred in the reclaimed plots. In the non-reclaimed plots few species and erratic occurrence of mites characterised plots Nr. 1 (without vegetation), Nr. 2 (moss), Nr. 6 (reed) and Nr. 7 (willow), when the opposite prevailed in plots Nr. 3 (grass, lichen, solitary birches) and Nr. 4 (birch forest). Mites were more abundant than in plots Nr. 3 and Nr. 4 (Tab. 1), but the communities were poorer, than those in the soil of the reclaimed plots Nr. 8–10.

The 8552 individuals belonged to 34 oribatid species and 3 undetermined taxa were recorded during one year observation on plots Nr. 1–4. Oribatid mites were generally the most dominant mite group, except in plot Nr. 2. where gamasid mites prevailed (Tab. 2). The abundance and frequency of oribatid mites in samples were correlated with the degree of vegetative cover (Tab. 2). More species of oribatids in increasing abundance were found in those plots with grass and herbs vegetation (plots Nr. 3 and 4) than in plots with only moss plot (Nr. 2) and those without vegetation (Nr. 1).

Oribatids did not establish themselves in the plots without vegetation (plot Nr.1.), though them probably tried to colonise it in November 1993 and in February. The colonisation in November was

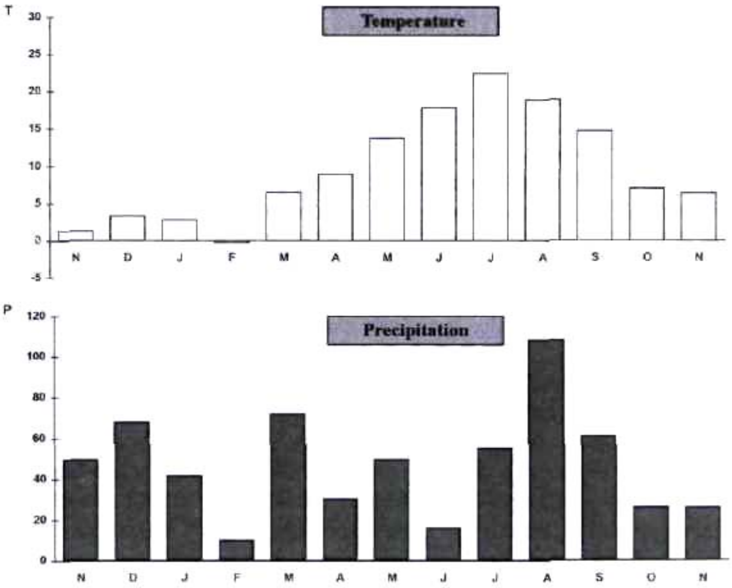

Fig. 1. Mean monthly temperatures (T – °C) and total monthly precipitation (P – mm) during the study.

Tab. 1. Comparison of mites in plots in unreclaimed and reclaimed parts of the study area. N – total abundance, N.o. – frequency in plots (occurrence of the observed species in the plots)

species \ Nr. of the site	10	8	11	9	4	3	5	2	6	7	1	total	N.o.
ACTINEDIDA	2	–	–	110	24	54	23	10	1	17	2	243	0.82
ACARIDIDA	–	–	–	–	2	–	–	1	–	–	–	3	0.18
GAMASIDA	3	7	11	9	1	8	7	3	–	–	–	49	0.73
ORIBATIDA	131	202	346	888	233	98	70	8	3	3	0	1982	1.00
total mites	136	209	357	1007	260	160	100	22	4	20	2	2277	1.00
Tectocepheus velatus	35	46	18	611	64	71	25	2	1	–	–	873	0.82
Oppiidae	4	4	80	3	97	6	44	–	1	1	–	240	0.82
Ceratozetes mediocris	20	39	142	166	18	1	–	–	1	–	–	387	0.64
Galumna lanceata	–	1	28	58	37	20	1	–	–	2	–	147	0.64
Scheloribates latipes	3	2	51	8	–	–	–	–	–	–	–	64	0.36
Liebstadia longior	16	2	18	24	–	–	–	–	–	–	–	60	0.36
Metabelba pulverosa	2	22	2	13	–	–	–	–	–	–	–	39	0.36
Suctobelbidae	–	–	4	4	17	–	–	–	–	–	–	25	0.27
Scheloribates laevigatus	5	2	1	–	–	–	–	–	–	–	–	8	0.27
Ctenobelba pectinigerera	1	35	–	–	–	–	–	–	–	–	–	36	0.18
Liacarus coracinus	4	23	–	–	–	–	–	–	–	–	–	27	0.18
Punctoribates punctum	16	–	–	–	–	–	–	6	–	–	–	22	0.18
Galumna elimnata	1	9	–	–	–	–	–	–	–	–	–	10	0.18
Eupelops occultus	3	1	–	–	–	–	–	–	–	–	–	4	0.18
Ceratozetes minutissimus	–	16	–	–	–	–	–	–	–	–	–	16	0.09
Achipteria coleoptrata	11	–	–	–	–	–	–	–	–	–	–	11	0.09
Protoribates sp.	3	–	–	–	–	–	–	–	–	–	–	3	0.09
Phthiracarus spp.	2	–	–	–	–	–	–	–	–	–	–	2	0.09
Minuthozetes semirufus	2	–	–	–	–	–	–	–	–	–	–	2	0.09
Nothrus silvestris	–	–	2	–	–	–	–	–	–	–	–	2	0.09
Haplozetes sp.	2	–	–	–	–	–	–	–	–	–	–	2	0.09
Oribatula tibialis	1	–	–	–	–	–	–	–	–	–	–	1	0.09
Ceratozetes minimus	–	–	–	1	–	–	–	–	–	–	–	1	0.09

probably correlated with low temperature and high precipitation (cf. Figs 1 and 2), and was stronger than that in February.

Oribatids were uncommon in the moss plot (Nr. 2) compared to plots with the litter layer (Nr. 3 and 4). Oribatids were present only in November 1993, December, March and June (Fig. 2). *Tectocepheus velatus*, Oppiidae, *Punctoribates punctum* and *Minuthozetes semirufus* were present in significant numbers (Tab. 2), whereas the other species were less frequently found and possibly chance colonists.

Oribatids were present in all months in plots Nr. 3 and 4, although not present in all samples (Fig. 2). Species number, diversity index and oribatid abundance – were higher in plot Nr. 4 than Nr. 3. Number of species, diversity indices and abundance values rapidly decreased in August and September in these two plots. The decrease was probably caused by the burning of vegetation combined with high summer temperatures (Fig. 2). The abundance of the common *Tectocepheus velatus* and Oppiidae species decreased rapidly (see Figs 3 and 4) followed by a rapid population growth in November 1994 in the case of Oppiidae in both plots, but of *Tectocepheus velatus* only in plot Nr. 3. Although the abundances of the uncommon oribatids appeared to change. They was hard to evaluate because the abundances of these species were very low.

The population density of *Tectocepheus velatus* was lower in plot Nr. 4 than in plot Nr. 3 (Fig. 3). Aggregation was apparent in plot 3, but not in plot Nr. 4. The aggregation occurred on four

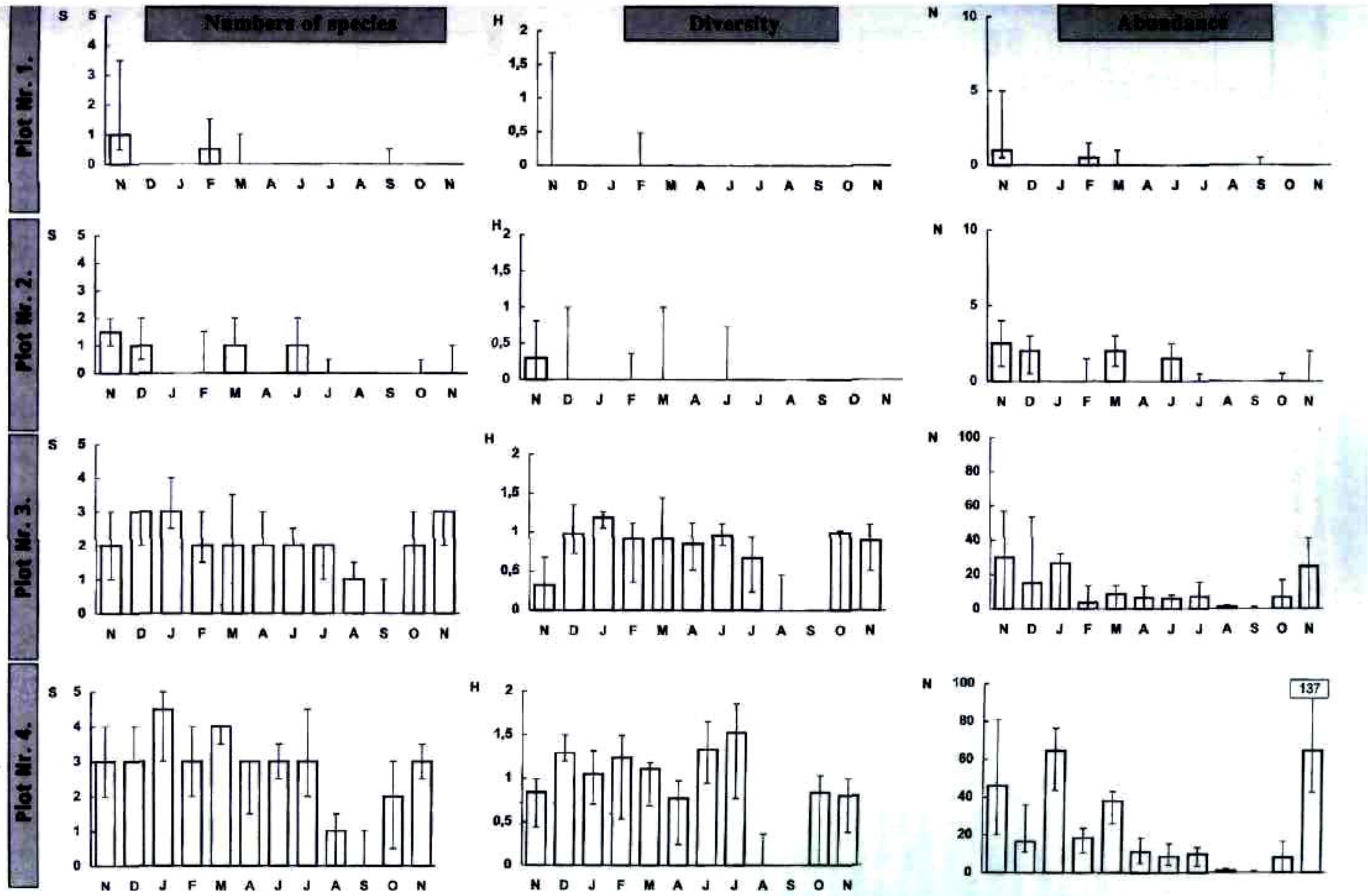

Fig. 2. Monthly medians of species number (S), diversity index (H) and abundance (N) of oribatid mites. Ranges = interquartile range.

Tab. 2. Comparison of mites in the plots in the unreclaimed part of the study area covered by different kinds of vegetation. N – total abundance, F – frequency in samples

	frequency				abundance				
species \ Nr. of the site	1	2	3	4	1	2	3	4	total
ACARIDIDA	0.60	0.08	0.06	0.03	3	26	11	74	114
ACTINEDIDA	0.06	0.27	0.38	0.32	29	160	165	132	486
GAMASIDA	0.13	0.35	0.62	0.35	36	215	450	118	819
ORIBATIDA	0.21	0.42	0.84	0.85	72	178	2305	4015	6570
total mites	0.31	0.62	0.88	0.85	140	579	2931	4339	7989
Oppiidae	0.08	0.20	0.71	0.79	14	74	1505	3091	4684
Tectocepheus velatus	0.04	0.13	0.72	0.58	6	32	635	291	964
Galumna lanceata	–	0.07	0.23	0.55	–	10	45	265	320
Suctobelbidae	–	–	0.15	0.21	–	–	71	150	221
Ceratozetes mediocris	0.03	0.01	0.01	0.33	7	1	1	191	200
Punctoribates punctum	0.01	0.10	0.01	0.01	2	26	7	2	37
Scheloribates laevigatus	0.06	0.01	0.03	0.02	10	2	13	4	29
Minuthozetes semirufus	0.01	0.03	0.01	0.03	7	12	3	6	28
Galumna elimnata	0.04	0.02	–	–	7	10	–	–	17
Brachychthoniidae	–	0.01	0.03	–	–	1	9	–	10
Chamobates spinosus	–	0.01	0.04	–	–	1	7	–	8
Achipteria coleoptrata	0.01	0.01	0.03	–	1	2	4	–	7
Liebstadia longior	0.02	–	–	–	5	–	–	–	5
Liebstadia similis	0.01	–	0.01	0.02	1	–	1	3	5
Oribatula tibialis	0.01	–	–	0.02	1	–	–	4	5
Metabelba pulverosa	0.01	0.01	–	–	2	2	–	–	4
Ceratozetes gracilis	–	–	0.01	0.01	–	–	1	2	3
Haplozetes sp.	0.01	–	–	–	3	–	–	–	3
Adoristes ovatus	–	0.01	–	0.01	–	1	–	1	2
Camisia sp.	–	–	–	0.01	–	–	–	2	2
Eupelops ocultus	0.01	–	–	–	2	–	–	–	2
Oribatula pallida	–	0.01	–	–	–	2	–	–	2
Platynothrus peltifer	–	0.01	0.01	–	–	1	1	–	2
Scheloribates latipes	0.01	–	0.01	–	1	–	1	–	2
Trichoribates trimaculatus	0.01	–	–	0.01	1	–	–	1	2
Belba sp.	–	–	–	0.01	–	–	–	1	1
Hypochthonius rufulus	–	–	–	0.01	–	–	–	1	1
Liacarus coracinus	0.01	–	–	–	1	–	–	–	1
Nothrus palustris	–	–	0.01	–	–	–	1	–	1
Scutovertex minutus	0.01	–	–	–	1	–	–	–	1
Xenillus tegeocranus	–	0.01	–	–	–	1	–	–	1

occasions, three of them correlated with high abundance. The abundance of *Tectocepheus velatus* peaked in November 1994 following low abundances in August and September. The population growth in October and November 1994, after burning of the plots in August, was smaller in plot Nr. 4. than Nr. 3.

Oppiidae species was more abundant than *Tectocepheus velatus* on both plot Nr. 3. and 4. Plot Nr. 4. had higher population densities of these species than plot Nr. 3. Aggregation was marked in November 1993 in both plots (Fig. 4) and in November 1994 in plot Nr. 4. No marked aggregation was observed in the summer. The samples with a high abundance of Oppiidae had a low abundance of *Tectocepheus velatus* (cf Figs 3 and 4). The minimum abundance of Oppiidae in both plots occurred in August and September. Abundance reached a maximum in November 1993 in plot Nr. 3.

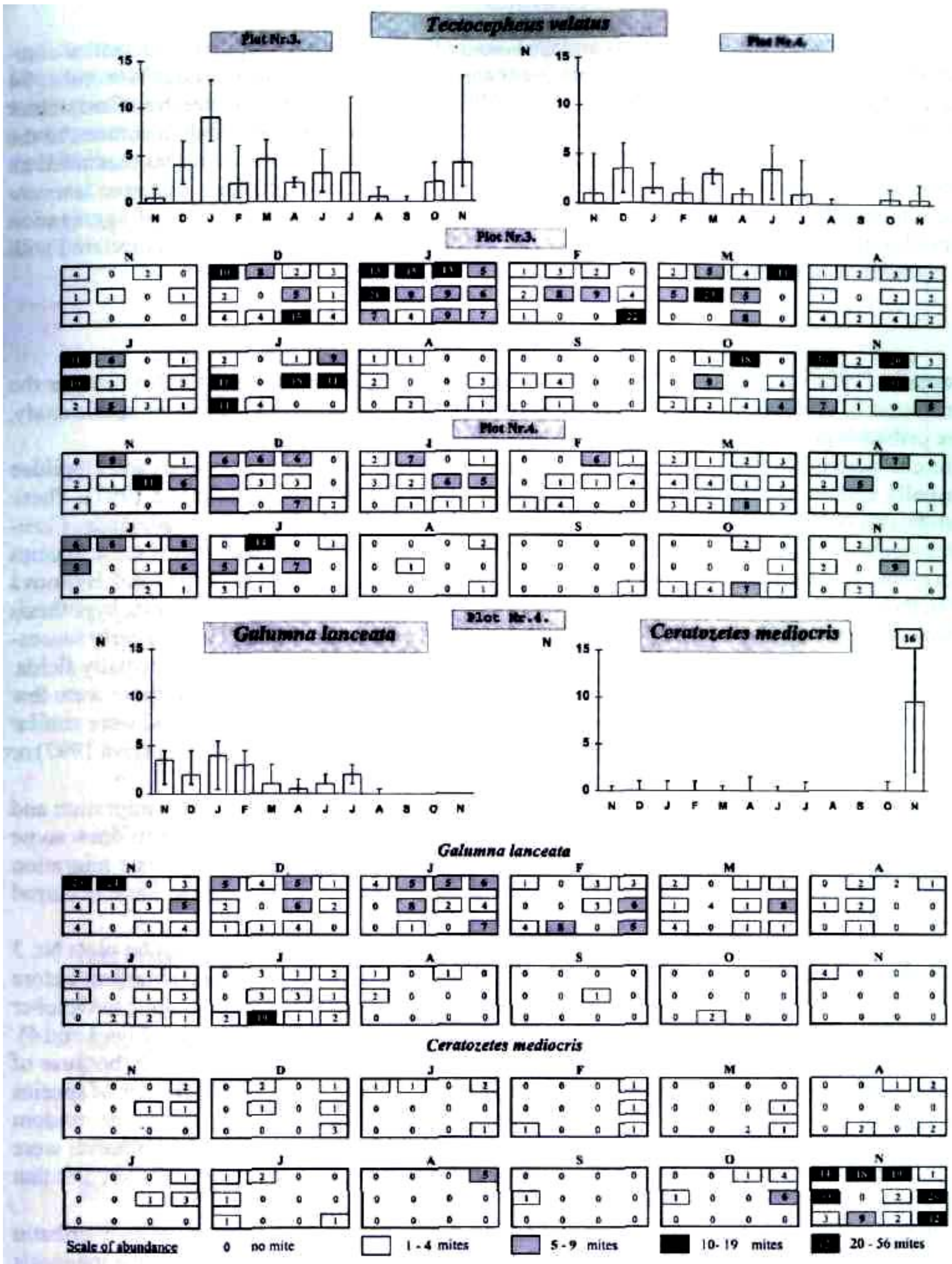

Fig. 3. Median abundance (N) of *Tectocepheus velatus* (Michael) in plots Nr. 3 and 4, and diagram of abundance values in samples. Median abundance (N) of *Galumna lanceata* Oudemans and *Ceratozetes mediocris* Berlese in plot Nr. 4, and diagram of abundance values in samples.

In plot Nr. 4 *Ceratozetes mediocris* and *Galumna lanceata* had low population densities compared with the previous species. The *Ceratozetes mediocris* population increased in November 94 and that of *Galumna lanceata* decreased after August (Fig. 3). Before September *Ceratozetes mediocris* was rare (Fig. 3). They were both aggregated in November 1994 and, in contrast to the other species, *Ceratozetes mediocris* were aggregated in August. The samples that contained an high abundance of *Ceratozetes mediocris* also contained an abundance Oppiidae. *Galumna lanceata* peaked in abundance in November 1993, which was correlated with the degree of aggregation observed in this month (Fig. 3). High abundance of *Galumna lanceata* was only correlated with high abundance of Oppiidae in one sample.

DISCUSSION

Hermosilla (1976) and Hutson (1980) suggested that actinedid and acaridid mites pioneer the colonization of reclaimed plots. This does not correspond whit what was observed in this study, where oribatids prevailed over acaridid and actinedid mites.

The characteristic mites in the Chvaletice slime sediment: *Tectocepheus velatus* and Oppiidae are usually eudominant in oribatid communities in fields (Seibert 1993, Hajmová 1997). These oribatids also occur in grassland, where they not as dominant as in fields and wastelands. *Ceratozetes mediocris* occurs in grassland as well (Hubert 1996). This indicates that if these species can disperse from grassland habitats into fields, as suggested by Seibert (1993) and Hajmová (1997), they could have similarly colonized the slime sediments in this study. A similar hypothesis has been proposed by Hejkal (1985) for the carabid (Coleoptera: Carabidae) fauna in early successional stages on spoil banks, where the carabids originated from open habitats, especially fields.

The fact, that the oribatid communities fluctuated in abundance, diversity and there were few species per sample, indicate that succession in non-reclaimed areas of the wasteland were similar to that in other pioneer habitats, like fields (Smrž & Jungová 1989, Seibert 1993, Hajmová 1997) or moss covered of roofs (Smrž 1992a).

For successful colonisation of slime sediments by oribatid mites need effective migration and reproduction strategies. Migration was hard to observe directly, but it is possible to draw some conclusions about it from the situation in the plot without vegetation. Short distance migration from the surrounding vegetation into the plot without vegetation is through to have occurred when conditions were humid.

On the other hand, probably no oribatid migration occurred after the vegetation on plots Nr. 3 and 4 was burnt. Species present after the fire were the same as those that were abundant before the fire. This observation indicates, that the mites that were uncommon from August to October probably survived the fire and dispersed (see Oppiidae and *Tectocepheus velatus* in Figs 3 and 4).

Passive long distance migration by wind into the plot without vegetation is likely because of the flatness of this part of the study area. This might account for the random occurrence of species (frequency in samples about 1%). This is also a common phenomenon in fields (see random occurrence of oribatids in Smrž & Jungová 1989, Seibert 1993, Hajmová 1997). Oribatids were perhaps transported by the wind from the reclaimed to the unreclaimed part, and the species that were sampled at low frequencies were those that were unable to survive.

Parthenogenetic reproduction facilitates rapid population growth and is one of the main oribatid strategies for colonizing pioneer habitats (Smrž 1992b). Luxton (1981b) reported parthenogenesis in *Tectocepheus velatus* and some species of the family Oppiidae. Another reproductive strategy is a short development period. The development period of some *Oppia* species is relatively short (from 14 to 42 days), while *Tectocepheus velatus* develops in about 102 days (Luxton 1981b).

Seasonal fluctuations in abundance of some *Oppia* species and *Tectocepheus velatus* have been reported in beech woodland soil (Luxton 1981a), moss (Hartnigk-Kümmel 1984), and fields and boundaries (Seibert, 1993). *Ceratozetes mediocris* varies in meadows (Hubert 1996). Population dynamics differed in these biotopes, even between fields and the adjacent boundaries (Seibert 1993), so it is hard to distinguish the effect of temperature and fire.

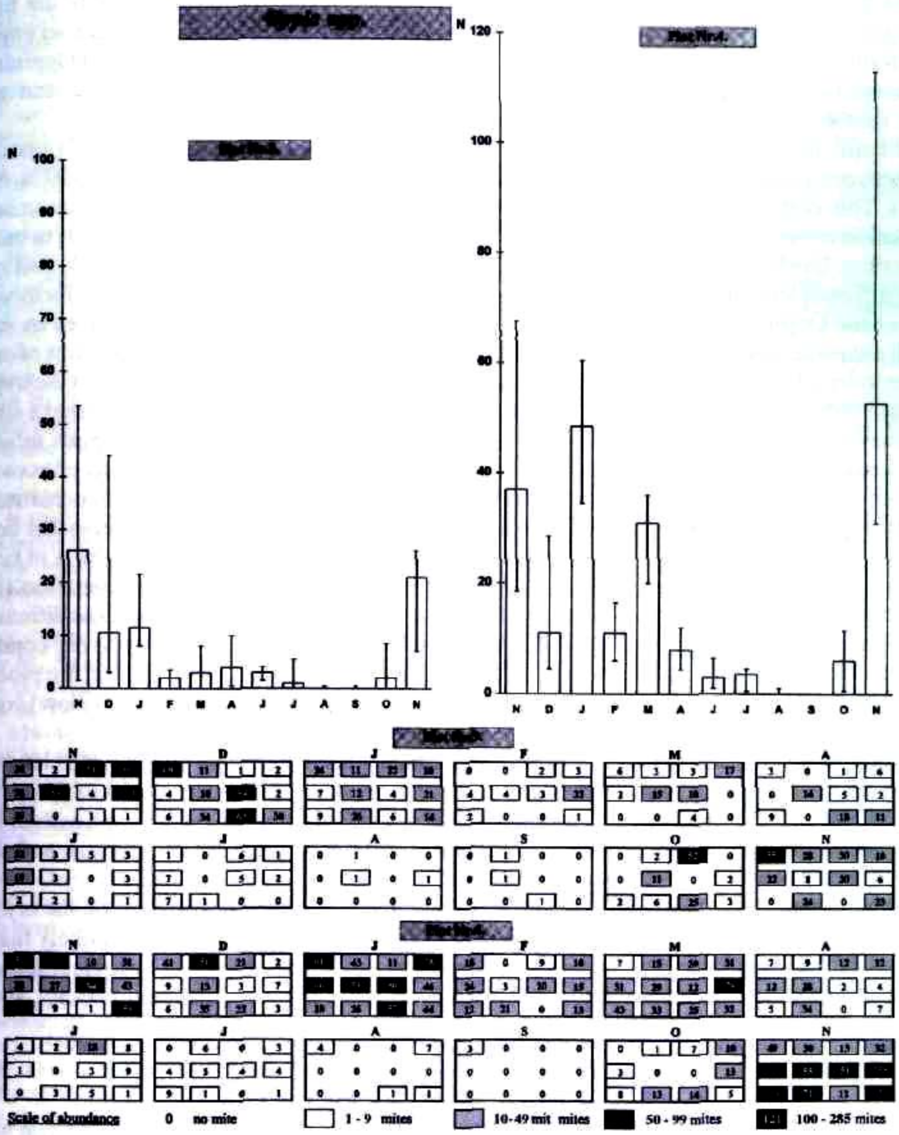

Fig. 4. Median abundance (N) of Oppiidae in plots Nr. 3 and 4, and diagram of abundance values in samples.

Temperature could be the reason for the decrease in the population of Oppiidae in June and July in plots Nr. 3 and 4. Similarly Beckmann (1988) observed a low abundance of Oppiidae species and *Tectocepheus velatus* in summer. *Tectocepheus velatus* reached average abundance and aggregation values in June and July. Another important factor was the burning of vegetation, which Curry (1986) regards as important in grasslands. The fire probably killed the majority of the mites, since the substratum was rather compact and offered few opportunities to hide.

The growth of the oribatid population after the fire seemed to be correlated with the input of plant ash, which served as a substratum for the growth of micro-organisms, which are an important food source for oribatids (Hartenstein 1962, Luxton 1972). The population growth of Oppiidae was more rapid than that *Tectocepheus velatus*. This may be related to the reproductive strategies of these species – duration of development and parthenogenesis.

Oribatid mites in pioneer habitats not only fluctuate in abundance in the course of a season, but also between samples taken simultaneously in one plot (Smrž & Jungová 1989, Smrž 1992a, Seibert 1993). This corresponds with the results obtained in this study. As both the substratum and the vegetation cover seemed homogeneous, the differences between the samples taken at to one time is puzzling. Smrž & Jungová (1989) obtained similar results from arable soils. The individual species show different tendencies to aggregate (see Luxton 1981c) and probably species like *Tectocepheus velatus* and Oppiidae have different aggregation trends in various habitats, influenced by factors, which are as yet unknown. Possible factors are assumed to be reproduction, distribution of organic matter, microclimate etc. (Mitchell 1978; Luxton 1981c). That is these results support the hypothesis that every sample probably came from a specific microhabitat. Smrž (1992) reported a stronger tendency to aggregate during periods of low population density in microarthropods inhabiting moss covered roofs. This reaction observed only in *Ceratozetes mediocris*. *Tectocepheus velatus* and Oppiidae seemed to behave conversely being more aggregated at population densities.

Although mites probably tried to colonise this substratum, they were not successful because of a lack of vegetation. Climatic factors like radiation and temperature fluctuate greatly in summer – with temperature reaching 70° C at the surface of the substratum lacking vegetation (Kovář pers.com.). The presence of grass or birch forest probably made the micro-climatic conditions more tolerable for mites, as suggested by Beckmann (1988). So species, more tolerant to dry conditions and high temperature, occur at low population densities an at increased densities in the plots with litter (grass and birch forest).The low mite densities in plots Nr. 6 (reed) and Nr. 7 (willow) could be due to by flooding and poor quality litter, respectively.

Beckmann (1988) and Koehler (1991) suggested that plant succession on reclaimed land modifies the microclimate and so influences soil mites. This is supported by the results of this study. In addition, vegetation produces litter, which is a food source for oribatids (as review Seastedt 1984). There was a difference between the non-reclaimed area covered by birch or grass and the reclaimed area covered by grass and shrubs.

It is hard to evaluate the effect that substratum toxicity might have any effect on the oribatids. Oribatids are extremely resistant to some heavy metals (Ludwig et al. 1991). It is likely that mite populations are probably more limited by precipitation and temperature than by toxic residues. On the other hand, the differences in plant cover, which could reflect substratum toxicity, strongly influenced the mites.

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Development, breeding type and diet of members of the *Amara communis* species aggregate (Coleoptera: Carabidae)

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Abstract. *Amara communis* species aggregate consists of four species: *A. communis* (Panzer, 1797), *A. convexior* Stephens, 1828, *A. makolskii* Roubal, 1923 and *A. pulpani* Kult, 1949. Rearing experiments proved breeding type without larval dormancy in all four species examined. *A. convexior*, *A. makolskii* and *A. pulpani* reproduced from mid-spring, *A. communis* in late spring and in summer. The mean developmental time from the 1st larval instar to the adult stage lasted in the laboratory conditions (21°C, natural daylight) 40.5 days in *A. makolskii*, 37.0 days in *A. convexior*, 36.5 days in *A. pulpani*, and 33.5 days in *A. communis*. There were no significant differences among the species in the developmental rate of the 3rd larval instar. However, the total preimaginal development and the developmental rate in the 1st, 2nd larval instars and the pupa was significantly faster in *A. communis* than in the other species. The 1st and the 2nd larval instars and the pupal stage lasted in all species nearly the same time, the 3rd larval instar lasted almost twice as long than the others. All species were able to survive on pure insect diet (pieces of *Tenebrio molitor* larvae) to adult stage. The overall survivorship from the 1st larval instar to adult emergence was more or equal to 60%, and there were no significant differences in survivorship of individual species. Adaptive significance of these life-history traits is discussed.

Life-history, Coleoptera, Carabidae, *Amara communis*, *A. convexior*, *A. makolskii*, *A. pulpani*

INTRODUCTION

Carabids (Coleoptera: Carabidae) are an important part of the epigeic fauna with unique morphology and various ecophysiological adaptations to this environment (Thiele 1977, Lövei & Sunderland 1996). The species from the genus *Amara* Bonelli, 1810 are a distinct group of species that play important role in natural and particularly agricultural ecosystems (Kokta 1988, Bracht Jorgensen & Toft 1997, Honěk & Jarošík 2000). However, experimentally founded data on their survivorship, timing of reproduction, and the length of postembryonal development are rare.

Bílý (1975) presents results of the laboratory and field studies on the reproduction biology of the heterogeneous subgenera complex *Celia* Zimmermann, 1832. *Amara ingenua* (Duftschmid, 1812), *A. municipalis* (Duftschmid, 1812) and *A. cursitans* Zimmermann, 1832 reproduce without larval dormancy from autumn to spring and possess only two larval instars. *A. bifrons* (Gyllenhal, 1810) and *A. praetermissa* (Sahlberg, 1827) lay eggs in late summer and in autumn and have larval dormancy in their reproduction cycle. *A. infima* (Duftschmid, 1812), living in heaths, has a similar reproduction cycle and the same breeding type as *A. ingenua*, *A. municipalis* and *A. cursitans*, but possesses three larval instars; field data on the annual cycle of this species in Denmark gives Schjotz-Christensen (1965). *A. (Paracelia) quenseli quenseli* (Schönherr, 1806), living in the alpine zone of mountains, has larval dormancy in its life cycle (Bílý 1975) and develops at least two years

(De Zordo 1979). *A.* (*Amarocelia*) *erratica* (Duftschmid, 1812), inhabiting also the unshaded mountain biotopes, develops without larval dormancy, but a part of larvae which hatched from eggs laid in late summer overwinter in the natural conditions of high mountains (Bílý 1971).

Hůrka & Ducháč (1980a, b) provide both laboratory and field data on five species of the subgenus *Bradytus* Stephens, 1828: *A.* (*B.*) *apricaria* (Paykull, 1790), *A.* (*B.*) *consularis* (Duftschmid, 1812), *A.* (*B.*) *fulva* (O.F. Müller, 1776), *A.* (*B.*) *majuscula* (Chaudoir, 1850), *A.* (*B.*) *crenata* Dejean, 1828 and three species of the subgenus *Curtonotus* Stephens, 1828: *A.* (*C.*) *aulica* (Panzer, 1797), *A.* (*C.*) *convexiuscula* (Marsham, 1802) and *A.* (*C.*) *gebleri* Dejean, 1831. The members of both subgenera have a breeding type with larval dormancy in the annual reproduction cycle. The larval development is therefore long (in one male of *A. majuscula*, reared in 1990, the development from the egg stage to the adult stage at the mean temperature 9.6 °C, min. 2.5 °C, max. 20 °C, lasted 178 days) and the species overwinter in both larval and adult stages (parental and grand-parental). Corresponding data based on field and laboratory studies on development of *A. apricaria*, *A. consularis* and *A. convexiuscula* in northern Kazakhstan are given by Lachmanov & Kotomenko (1974).

This study presents new data on reproduction cycle, developmental length and survivorship on meat diet of *Amara* (*A.*) *communis* species aggregate from the nominotypical subgenus *Amara*. So far, data from the rearing experiments are given for *A.* (*A.*) *eurynota* (Panzer, 1797) (Bílý 1972), *A.* (*A.*) *similata* (Gyllenhal, 1810) (Lachmanov & Kotomenko 1974, Bracht Jorgensen & Toft 1997), *A.* (*A.*) *famelica* Zimmermann, 1832, *A.* (*A.*) *littorea* C.G. Thomson, 1857 and *A.* (*A.*) *proxima* Putzeys, 1866 (Hůrka 1998) only. All the studied species develop without larval dormancy. The species aggregate studied consists of four species: *A.* (*A.*) *communis* (Panzer, 1797), *A.* (*A.*) *convexior* Stephens, 1828, *A.* (*A.*) *makolskii* Roubal, 1923 and *A.* (*A.*) *pulpani* Kult, 1949. The diagnosis of the species aggregate, in both the larval and adult stages, and the differentiation of the members of the aggregate, including eggs and larvae, are given by Hůrka & Růžičková (1999).

MATERIAL AND METHODS

Experiments started with adults caught in the field (see Appendix). The sex of the individuals was determined, and both adults and larvae were raised at 21±1 °C and under natural photoperiod (50° 06' N 14° 16'E), following the technique described by Hůrka (1996). Adults were fed by the mixed diet of oat flakes and pieces of *Tenebrio molitor* larvae; larvae by pieces of *T. molitor* only. The onset of reproduction (indicated by laying eggs), the length of preimaginal development of each stage and survivorship were monitored in 24h interval.

Survivorship and developmental lengths of individual species were compared for individual larval instars (larva 1–3), pupal stage, and the whole preimaginal development (excluding eggs, i. e. larva 1 – pupa) by one-way analyses of variance. Survivorship was examined with the survival from the initial cohort of newly emerged 1st instar larvae of each species described by the Weibull function (Cox & Oakes 1984, Honěk et al. 1998). Homogeneity of variance of developmental rates among species was checked by Bartlett's test, and the differences in developmental rates tested by LSD tests (Sokal & Rohlf 1981). The adequacy of all fitted statistics was checked by plotting standardised residuals against fitted values, and by the normal probability plots of the fitted values (Crawley 1993).

RESULTS

Development

All juvenile stages of the members of this species aggregate developed on the meat diet fast and without larval dormancy. The mean total preimaginal developmental time (excluding eggs) lasted in the laboratory conditions from 40.5 days in *Amara makolskii*, through 37.0 days in *A. convexior* and 36.5 days in *A. pulpani*, to 33.5 days in *A. communis* (Fig. 1). The species spent about 20% of the total preimaginal development in the 1st, 2nd larval instar and in pupa, and the development lasted in each of these stages nearly the same time. The 3rd larval instar, however, lasted in all the

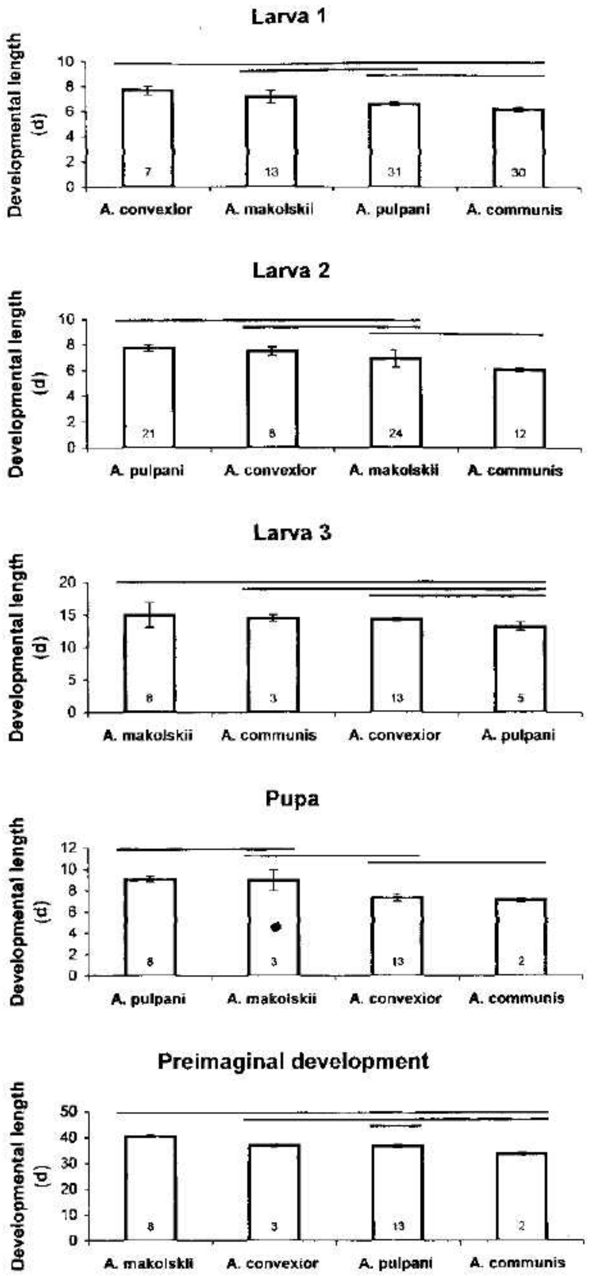

Fig. 1. Developmental length (± standard error) in days of four species of *Amara* (*A.*) *communis* species aggregate on meat diet (pieces of *Tenebrio molitor* larvae). Figures in the bars indicate number of individuals of each species, the horizontal lines on the top of the bars show groups of species not significantly different by least significant differences (LSD).

species almost twice as long than the other stages. The species with the shortest total preimaginal time, *A. communis*, developed significantly faster than the other species in all stages where the differences in developmental rate appeared significant: in the 1st instar (F = 5.23; df = 3, 77; p = 0.002), 2nd instar (F = 5.41; df = 3, 62; p = 0.002), pupa (F = 10.09; df = 3, 22; p = 0.0002), and the whole preimaginal development (F = 5.58; df = 3, 22; p = 0.005). Interestingly, the developmental rate among species did not differ in the 3rd larval instar that lasted the longest time (F = 0.83; df = 3, 25; p = 0.49). The differences in developmental rate among species were most striking in the pupal stage.

The development of the 1st larval instar of *A. communis* was significantly (t = 2.88; df = 41; p = 0.006) shorter than that of *A. makolskii*, and the development of the 2nd instar of *A. communis* was significantly shorter than that of *A. pulpani* (t = 2.50; df = 43; p = 0.02) and *A. convexior* (t = 2.35; df = 27; p = 0.03). The pupal development of *A. communis* (t = 3.43; df = 19; p = 0.003) and *A. convexior* (t = 2.52; df = 14, p = 0.02) was significantly shorter than *A. pulpani*, and *A. communis* also developed significantly (t = 2.74; df = 8, p = 0.03) faster than *A. makolskii*. The total preimaginal developmental time of *A. communis* was significantly (t = 2.81; df = 19; p = 0.01) shorter than that of *A. pulpani* (Fig. 1).

The reproduction of *A. makolskii*, *A. pulpani* and *A. convexior* started approximately in the same time, from about mid-spring. However, the onset of reproduction of the species with the fastest development, *A. communis*, was shifted to late spring and the summer.

Survivorship

The larvae fed on the pure insect diet were able to survive to adult stage (Fig. 2). The overall survivorship from the 1st larval instar to adult emergence was more or equal to 60%, and the highest mortality appeared between the 2nd and 3rd larval instar. All larvae that survived to the 3rd instar except an individual of *Amara makolskii* successfully pupated and emerged as adults (Fig. 2). There were no significant differences in survivorship of individual species (χ^2= 0.93, df = 3, p = 0.82).

DISCUSSION

The *Amara communis* species aggregate include two rather recently described species, *A. makolskii* and *A. pulpani*. Both Kult (1949) and Burakowski (1957, 1967) (describing *A. makolskii* as *A. pseudocommunis* Burakowski, 1957) mentioned in descriptions of their new species the specific ecological requirements of the newly described taxa. Kult emphasized the occurrence of *A. pulpani* on dry heath soils, mostly in hills. Burakowski gives the birch mixed forests on the sandy soils as the habitat of *A. makolskii*. The other two species are more eurotypic, *A. convexior* rather xerophilous, *A. communis* rather hygrophilous.

Based on our results, the reproduction of *A. makolskii*, *A. pulpani* and *A. convexior* takes place in conditions of central Europe from about mid-spring, *A. communis* reproduces in late spring and in the summer. Also Greenslade (1965) gave the peak occurrence of trapped *A. communis* adults from the Silwood Park, Berkshire, England, consistently with our results, in late May and early June; teneral adults of the new generation were active in September. On the other hand, according to the field studies in the Kampinoska Forest near Warsaw, Burakowski (1967) mentioned the copulation and oviposition of *A. makolskii* from July to autumn, contrary to our results. The larvae were collected from July to November, pupae from August to November, and freshly emerged, teneral adults from August to December; the adults overwintered. Burakowski (1967) postulates phenological correlation of sexual activity of this species with the ripening and falling of birch seeds in the late summer. According to this author, the seeds represent an important, supplementary food for the adults, necessary in obtaining sexual maturity, mating and oyiposition. Burakowski (1967) is certainly right in connecting *A. makolskii* with birch trees, since the occurrence of *A. makolskii* is really associated with the birch mixed forests. Nevertheless, the birch seeds can be eaten by adults of the newly emerged generation already in the period of dormancy of gonads before overwintering, and naturally also after hibernation in the period of activation of gonads, from the soil seed bank. The phenological correlation of *A. makolskii* reproduction with the falling of birch seeds in the late summer is therefore not probable and not necessary. In our laboratory stocks, the females found in their natural habitat in mid-April have laid eggs from late April to mid-May.

All juvenile stages of the members of the *A. communis* species aggregate developed fast and, as in other members of the nominotypical subgenus *Amara* so far studied, without dormancy. Consequently, all species of this species aggregate belong to the breeding type without larval dormancy in their annual cycle. All are univoltine in conditions of northern and central Europe, with only one generation in the year. The mean developmental time from the 1st larval instar to the adult stage lasted in the laboratory conditions (21°C, natural daylight) from 40.5 in *A. makolskii* to 33.5 days in *A. communis*, and the latter species developed significantly faster than the other in all stages where the differences in developmental rate among individual species appeared significant.

The 1st and the 2nd larval instars and the pupal stage lasted in all species of the aggregate nearly the same time, the 3rd larval instar, however, developed almost twice as long than the other stages. Moreover, developmental rates among species differed in all the stages except the 3rd instar, and these differences were most striking in the pupal stage. This developmental pattern suggests species-specific selection on developmental rates in all the stages except the 3rd instar. In the 3rd instar, the results rather suggest a developmental flexibility related to environmental conditions, without species-specific constraints on developmental rate. The 3rd instar is the largest, long-lasting and most voracious stage. As a consequence, the 3rd instar determine, in a great extent, the final size of adult. As the adult size is closely correlated to fitness (Honěk 1993), there seems be an adaptive response in the length of the 3rd instar to environmental conditions that might enable to optimise the adult size. If so, the same developmental length of all species in the 3rd instar may be a consequence of excessive supply of uniform food in uniform laboratory conditions. On the other hand, the most striking differences in developmental rates among species in pupal stage might suggest

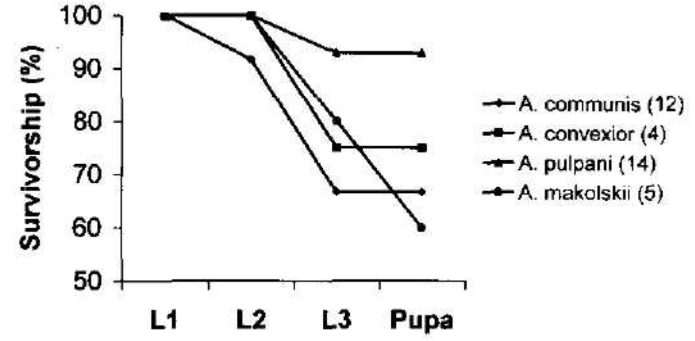

Fig. 2. Proportion (%) of survivorship on meat diet (pieces of *Tenebrio molitor* larvae) of four species of *Amara* (*A.*) *communis* species aggregate. Figures in legend are initial cohort sizes of newly emerged 1st instar larvae of each species.

strong species-specific constraints on developmental rates in immobile stage, that might be selected under weaker influence of environmental conditions than in larval stages searching for food.

Larvae were fed on insect diet (pieces of *Tenebrio molitor* larvae), and all four species were able to survive on the pure insect diet to the adult stage. Mortality was rather low and did not differ among species. Larvae of the genus *Amara* are traditionally considered as insectivorous (Burakowski 1967, Luff 1993), occasionally biting roots (Burmeister 1939), and in laboratory stocks are usually kept on meat diet (Bílý 1971, 1972, 1975, Hůrka & Ducháč 1980a, b, Desender et al. 1986, Desender 1988, Hůrka 1998). Phytophagy was first suggested by Thompson (1979) and Hůrka (1988) that reared some species on oak flakes. Bracht Jorgensen & Toft (1997) made experiments with larvae of *A. similata* on various food. Surprisingly, the lowest mortality was found on seeds of *Capsella bursa-pastoris*, and larvae of this species were unable to finish preimaginal development on insect diet. Recent results (Saska & Jarošík in prep.) suggest that larvae of the genus *Amara* can be distinguished into groups of granivorous, omnivorous, and insectivorous species. The *A. communis* species aggregate seems to belong to the insectivorous species.

Acknowledgements

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APPENDIX

The origin of reared adults

Amara communis – Slovakia or., Latorica River, Ból (code of mapping square 7596, for details see (Pruner & Míka, 1996)), flood debries, 11. iv. 1987, J. Růžička & A. Růžičková leg., Bohemia bor. or., Vrchlabí (5359), 20. iv. 1997, P. Saska leg.; *A. convexior* – Bohemia centr., Nové Mlýny pr. Vlašim (6255), Bohemia centr., Praha-Háje (5952), 16. iv. 1986, J. Růžička leg., Bohemia centr., Praha-Trója, Havránka (5852), 23. iv. 1993, Bohemia centr., Praha-Čimice (5852), 27. iv. 1996, 19. iv. 1997, K. Hůrka leg.; *A. makolskii* – Bohemia occ., peat bog Soos (5840), 14. iv. 1987, J. Hejkal leg.; *A. pulpani* – Bohemia occ., Kraslice, Tisovec (5641), heath, 2. iv. 1987, 19. iv. 1990, J. Hejkal leg., Bohemia occ., Kraslice, Šibenični vrch (5641), heath, 16. v. 1989, 23. iv. 1995, J. Hejkal leg.

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BOOK REVIEW

WHELAN R. J.: **The Ecology of Fire**. Cambridge University Press, Cambridge, 1995. x+346 pp. Price not stated.

I shall first let the author speak for himself about the central questions raised in his monograph. "Wildfires kill many animals, but are populations of animals affected? How do animals survive the passage of fire? Do frequent fires cause changes in plant community composition? Why do some tree species survive and other die in a fire? How important is long-distance seed dispersal in vegetation recovery after fire? How does fire affect plant-herbivore interactions and predator-prey interactions? What are the effects of frequently applied, out of season fires for land management?" Many more such basic problems are covered in eight richly illustrated, clearly written chapters, each outlining not only the present knowledge, but equally stressing the outstanding questions.

The phenomenon of wildfire is usually seen as something marginal ad hoc locally catastrophic, and generally of little significance. Quite different are the views of ecology students working in those parts of the world where extensive fires occur regularly and with stochastic periodicity. They appreciate the selective force of this phenomenon, as well as the problem of explaining adaptive survival strategies and reproductive adjustments of individuals, species (particularly those of woody plants) and ecosystems to the fire.

The author treats the subject comprehensively, lucidly, and from the view of short-term effects and adaptations. He refrains from treating it speculatively on a geological time scale, feeling that we do not have a sufficient amount of accurate data on short-term effects and strategies. To me this attitude seems a little unfortunate, since I believe a proximate explanation must be linked with a historical perspective. It should take into account all the extensive fires occurring during major biotic catastrophes, and providing probably background for major adaptations as well as for fire affected speciations. However, everybody interested in the effects of fire on plants, animals and ecosystems as seen in the ecological time perspective will find here not only a large number of data, hypotheses and questions concerning this phenomenon, but also an appealing incentive for its further study. The reared may be surprised to learn the present monograph is on of 19 on ecological fire effects which have been published since 1982.

The book is warmly recommended to everybody interested in the only seemingly "exotic" phenomenon of extensive wildfires. The reader will learn, at least, these fires result not only in mass deaths of individual organisms, but also provide new life opportunities, and are necessary for the survival and reproduction of many species and ecosystems.

Pavel Štys

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Check-list of the molluscs (Mollusca) of the Czech Republic

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Abstract. The Check-list of 237 species of molluscs known so far from the Czech Republic is presented and the proportions of their ecological and zoogeographical groups are given. The status of threat is given for every species (Red List).

Distribution, Check-list, Red List, Mollusca, Czech Republic

INTRODUCTION

The research on molluscs has an almost 150 year old tradition in the Czech Lands. A first attempt to give an overview of molluscs in Bohemia was made by Schöbl (1860). This work was soon overridden by the detailed work of Slavík (1868). This initiated a more intensive interest in molluscs in Bohemia, which resulted in the renowned monograph of Uličný (1892–1895). Data covering the following 50 years were summarized by Ložek (1948). One year later, Ložek (1949) covered the entire territory of (then) Czechoslovakia. The latest monograph dealing with all recent molluscs of Czechoslovakia was published by Ložek (1956) as well. A more recent comprehensive work on molluscs covered only fresh-water species within the Czech Republic (Beran 1998).

The last complete list of the Czech Republic's molluscs was written 37 years ago (Ložek 1964) and was included in his work on Quaternary molluscs of Czechoslovakia. Naturally, our knowledge on the mollusc fauna of the Czech Republic has expanded since then. An up-to-date species list is badly needed. Many species not recorded formerly from the Czech Republic have been found within the last four decades. These are particularly species with an restricted range; either occuring in a few scattered and isolated sites or recorded in few localities close to the country's borders. A second group of species that has been getting more important over the last decade is non-native species spreading due to human activities. Another reason for new species to be listed is the advance made in taxonomy on various levels. Taking into account the practical usage of this invertebrate taxon of high indicator value in conservation we have complemented the inventory by an up-dated Red List.

SURVEY OF SPECIES

Class:	Gastropoda			
Subclass:	Prosobranchia			
Superorder:	Archaeogastropoda			
Order:	Neritimorpha			
Superfamily:	Neritoidea			
Family:	Neritidae			
	Theodoxus Montfort, 1810			
	danubialis (C. Pfeiffer, 1828)		M	CR
	fluviatilis (Linnaeus, 1758)	B		EX
Superorder:	Caenogastropoda			
Order:	Architaenioglossa			
Superfamily:	Ampullarioidea			
Family:	Viviparidae			
	Viviparus Montfort, 1810			
	acerosus (Bourguignat, 1862)		M	EN
	contectus (Millet, 1813)	B	M	NT
	= *V. viviparus* (Linnaeus, 1758)			
	viviparus (Linnaeus, 1758)	B		VU
	= *V. fasciatus* (O. F. Müller, 1774)			
Order:	Neotaenioglossa			
Superfamily:	Rissooidea			
Family:	Hydrobiidae			
Subfamily:	Potamopyrginae			
	Potamopyrgus Stimpson, 1865			
	antipodarum (Gray, 1843) 2) 39)	B	M	NE
	= *P. jenkinsi* (E. A. Smith, 1889)			
Subfamily:	Horatiinae			
	Alzoniella Giusti et Bodon, 1984			
	slovenica (Ložek et Brtek, 1964) 34)		M	EN
	= *Belgrandiella slovenica komenskyi* Hudec, 1972 13)			
Subfamily:	Amnicolinae			
	Bythinella Moquin-Tandon, 1856			
	austriaca (von Frauenfeld, 1857) agg.	B(VU)	M(NT)	VU
Subfamily:	Lithoglyphinae			
	Lithoglyphus Hartmann, 1821			
	naticoides (C. Pfeiffer, 1828)		M	EN
Family:	Bithyniidae			
	Bithynia Leach, 1818			
	leachii (Sheppard, 1823) 38)		M	CR
	tentaculata (Linnaeus, 1758)	B	M	LC
Superfamily:	Aciculoidea			
Family:	Aciculidae			
	Acicula Hartmann, 1821			
	parcelineata (Clessin, 1911)		M	CR
	Platyla Moquin-Tandon, 1856			
	polita (Hartmann, 1840)	B	M	VU
Superorder:	Heterostropha			
Order:	Ectobranchia			
Superfamily:	Valvatoidea			

Family:	Valvatidae			
	Valvata O. F. Müller, 1774			
	cristata O. F. Müller, 1774	B(LC)	M(NT)	LC
	macrostoma Mörch, 1864 1) 22)	B		CR
	= *V. pulchella* auct. nec Studer, 1820			
	piscinalis (O. F. Müller, 1774)	B	M	NT
Subclass:	Pulmonata			
Superorder:	Basommatophora			
Order:	Hygrophila			
Superfamily:	Acroloxoidea			
Family:	Acroloxidae			
	Acroloxus Beck, 1838			
	lacustris (Linnaeus, 1758)	B	M	LC
Superfamily:	Lymnaeoidea			
Family:	Lymnaeidae			
	Galba Schrank, 1803			
	truncatula (O. F. Müller, 1774)	B	M	LC
	Stagnicola Jeffreys, 1830			
	corvus (Gmelin, 1791)	B	M	LC
	= *Lymnaea palustris* (O. F. Müller, 1774) part. 3)			
	fuscus (C. Pfeiffer, 1821) 12)	B		NE
	occulta (Jackiewicz, 1959) 1) 32)	B		CR
	turricula (Held, 1836)	B	M	LC
	= *Lymnaea palustris* (O. F. Müller, 1774) part. 3)			
	Radix Montfort, 1810			
	ampla (Hartmann, 1821) 4)	B(NT)	M(EN)	VU
	auricularia (Linnaeus, 1758)	B	M	LC
	ovata (Draparnaud, 1805) 4)	B	M	LC
	peregra (O. F. Müller, 1774)	B	M	LC
	Myxas J. Sowerby, 1882			
	glutinosa (O. F. Müller, 1774)	B		EX
	Lymnaea Lamarck, 1799			
	stagnalis (Linnaeus, 1758)	B	M	LC
Superfamily:	Physoidea			
Family:	Physidae			
	Aplexa Fleming, 1820			
	hypnorum (Linnaeus, 1758)	B(NT)	M(VU)	VU
	Physa Draparnaud, 1801			
	fontinalis (Linnaeus, 1758)	B	M	NT
	Physella Haldemann, 1843			
	acuta (Draparnaud, 1805) 2)	B	M	LC
Superfamily:	Planorboidea			
Family:	Planorbidae			
	Planorbis O. F. Müller, 1774			
	carinatus O. F. Müller, 1774	B	M	EN
	planorbis (Linnaeus, 1758)	B	M	LC
	Anisus Studer, 1820			
	leucostoma (Millet, 1813)	B	M	NT
	septemgyratus (Rossmässler, 1835) 14)		M	CR
	spirorbis (Linnaeus, 1758)	B	M	VU
	vortex (Linnaeus, 1758)	B	M	LC
	vorticulus (Troschel, 1834)	B	M	CR
	Bathyomphalus Charpentier, 1837			
	contortus (Linnaeus, 1758)	B	M	LC

	Gyraulus Charpentier, 1837			
	acronicus (A. Férussac, 1807)	B(EN)	M(CR)	EN
	albus (O. F. Müller, 1774)	B	M	LC
	crista (Linnaeus, 1758)	B	M	LC
	laevis (Alder, 1838)	B(NT)	M(VU)	VU
	parvus (Say, 1817)[2,15]	B	M	NE
	rossmaessleri (Auerswald, 1852)[47]		M	CR
	Hippeutis Charpentier, 1837			
	complanatus (Linnaeus, 1758)	B	M	LC
	Segmentina Fleming, 1818			
	nitida (O. F. Müller, 1774)	B	M	VU
	Planorbarius Froriep, 1806			
	corneus (Linnaeus, 1758)	B	M	LC
	Menetus H. & A. Adams, 1855			
	dilatatus (Gould, 1841)[2,9]	B		NE
	Ancylus O. F. Müller, 1774			
	fluviatilis O. F. Müller, 1774	B	M	LC
	Ferrissia Walker, 1903			
	clessiniana (Jickeli, 1882)[2,21,42]	B	M	NE
	= *F. wautieri* (Mirolli, 1960)			
Superorder:	Eupulmonata			
Order:	*Actophila*			
Superfamily:	Ellobioidea			
Family:	Carychiidae			
	Carychium O. F. Müller, 1774			
	minimum O. F. Müller, 1774	B	M	LC
	tridentatum (Risso, 1826)	B	M	LC
Order:	Stylommatophora			
Suborder:	Orthurethra			
Superfamily:	Cochlicopoidea			
Family:	Cochlicopidae			
	Cochlicopa A. Férussac, 1821			
	lubrica (O. F. Müller, 1774)	B	M	LC
	lubricella (Rossmässler, 1835)	B	M	LC
	nitens (M. von Gallenstein, 1848)[40]	B	M	CR
	repentina Hudec, 1960[26]	B	M	NE
Superfamily:	Pupilloidea			
Family:	Orculidae			
	Orcula Held, 1838			
	dolium (Draparnaud, 1801)		M	VU
	Sphyradium Charpentier, 1837			
	doliolum (Bruguière, 1792)	B	M	NT
Family:	Chondrinidae			
	Granaria Held, 1838			
	frumentum (Drapanaud, 1801)	B	M	NT
	Chondrina Reichenbach, 1828			
	avenacea (Bruguière, 1792)	B		EN
	clienta (Westerlund, 1883)		M	VU
Family:	Pupillidae			
	Pupilla Fleming, 1828			
	alpicola (Charpentier, 1837)[5,44]	B	M	CR
	muscorum (Linnaeus, 1758)	B	M	NT
	sterrii (Voith, 1840)	B	M	VU
	triplicata (Studer, 1820)	B	M	VU
	= *P. bigranata* auct. nec (Rossmässler, 1839)			

Family:	**Pyramidulidae**			
	Pyramidula Fitzinger, 1833			
	pusilla (Vallot, 1801)[24]	B(EN)	M(VU)	VU
	= *P. rupestris* (Draparnaud, **1801**) **part.**			
Family:	Valloniidae			
Subfamily:	Valloniinae			
	Vallonia Risso, 1826			
	costata (O. F. Müller, 1774)	B	M	LC
	enniensis (Gredler, 1856)	B	M	EN
	excentrica Sterki, 1893	B	M	NE
	pulchella (O. F. Müller, 1774)	B	M	LC
Subfamily:	Acanthinulinae			
	Acanthinula Beck, 1847			
	aculeata (O. F. Müller, 1774)	B	M	NT
Family:	Vertiginidae			
Subfamily:	Truncatellininae			
	Columella Westerlund, 1878			
	aspera Waldén, 1966[37]	B		LC
	edentula (Draparnaud, 1805)	B	M	LC
	Truncatellina Lowe, 1852			
	claustralis (Gredler, 1856)	B(EN)	M(VU)	EN
	costulata (Nilsson, 1823)		M	CR
	cylindrica (A. Férussac, 1807)	B	M	LC
Subfamily:	Vertigininae			
	Vertigo O. F. Müller, 1774			
	alpestris Alder, 1838	B	M	VU
	angustior Jeffreys, 1830	B	M	VU
	antivertigo (Draparnaud, 1801)	B	M	VU
	geyeri Lindholm, 1925[45]	B		CR
	moulinsiana (Dupuy, 1849)[23]	B	M	CR
	pusilla O. F. Müller, 1774	B	M	NT
	pygmaea (Draparnaud, 1801)	B	M	NT
	ronnebyensis (Westerlund, 1871)[50]	B		CR
	substriata (Jeffreys, 1833)	B	M	NT
Superfamily:	Buliminoidea			
Family:	Buliminidae			
	Chondrula Beck, 1837			
	tridens (O. F. Müller, 1774)	B	M	VU
	Ena Turton, 1831			
	montana (Draparnaud, 1801)	B	M	NT
	Merdigera Held, 1838			
	obscura (O. F. Müller, 1774)	B	M	LC
	Zebrina Held, 1838			
	detrita (O. F. Müller, 1774)	B(EN)	M(CR)	EN
Suborder:	Sigmurethra			
Superfamily:	Clausilioidea			
Family:	Clausiliidae			
Subfamily:	Alopiinae			
	Cochlodina A. Férussac, 1821			
	cerata opaviensis Brabenec et Mácha, 1960[16][19]		M	EN
	commutata (Rossmässler, 1836)	B(VU)	M(EN)	VU
	= *C. costata* (C. Pfeiffer, 1828)			
	dubiosa corcontica Brabenec, 1967[17]	B		EN
	laminata (Montagu, 1803)	B	M	LC
	orthostoma (Menke, 1828)	B(VU)	M(NT)	VU

	Itala O. Boettger, 1877			
	ornata (Rossmässler, 1836)	B(VU)	M(EN)	VU
Subfamily:	Clausiliinae			
	Ruthenica Lindholm, 1924			
	filograna (Rossmässler, 1836)	B	M	VU
	Pseudofusulus H. Nordsieck, 1977			
	varians (C. Pfeiffer, 1828)	B(CR)	M(EX?)	CR
	Macrogastra Hartmann, 1841			
	badia (C. Pfeiffer, 1828)	B(EN)	M(CR)	EN
	= *Iphigena mucida badia* (Rossmässler, 1836)			
	latestriata (A. Schmidt, 1857)		M	CR
	= *M. borealis* (O. Boettger, 1878) [49]			
	plicatula (Draparnaud, 1801)	B	M	NT
	tumida (Rossmässler, 1836)	B(EN)	M(VU)	VU
	ventricosa (Draparnaud, 1801)	B	M	NT
	Clausilia Draparnaud, 1805			
	bidentata (Ström, 1765)	B		EN
	cruciata (Studer, 1820)	B	M	VU
	dubia Draparnaud, 1805	B	M	LC
	parvula Férussac, 1807	B	M	NT
	= *C. rugosa parvula* Férussac, 1807 [48]			
	pumila C. Pfeiffer, 1828	B	M	LC
Subfamily:	Baleinae			
	Laciniaria Hartmann, 1844			
	plicata (Draparnaud, 1801)	B	M	NT
	Alinda H. & A. Adams, 1855			
	biplicata (Montagu, 1803)	B	M	LC
	Balea Gray, 1824			
	perversa (Linnaeus, 1758)	B	M	VU
	Vestia P. Hesse, 1916			
	gulo (E. A. Bielz, 1859)		M	CR
	ranojevici moravica (Brabenec, 1952)		M	EN
	turgida (Rossmässler, 1836)	B(EN)	M(VU)	VU
	Bulgarica O. Boettger, 1877			
	cana (Held, 1836)	B	M	EN
	nitidosa (Uličný, 1893)	B		VU
Superfamily:	Succineoidea			
Family:	Succineidae			
	Succinella Mabille, 1871			
	oblonga (Draparnaud, 1801)	B	M	LC
	Succinea Draparnaud, 1801			
	putris (Linnaeus, 1758)	B	M	LC
	Oxyloma Westerlund, 1885			
	elegans (Risso, 1826)	B	M	NT
	= *Succinea pfeifferi* Rossmässler, 1835			
	= *S. dunkeri* L. Pfeiffer, 1865			
Superfamily:	Achatinoidea			
Family:	Ferussaciidae			
	Cecilioides A. Férussac, 1814			
	acicula (O. F. Müller, 1774)	B	M	LC
Superfamily:	Punctoidea			
Family:	Punctidae			
Subfamily:	Punctinae			
	Punctum Morse, 1864			
	pygmaeum (Draparnaud, 1801)	B	M	LC

Subfamily:	Helicodiscinae			
	Hebetodiscus **H. B. Baker, 1929**			
	inermis (Baker, 1929) 2) 36)	B		NE
	= *Helicodiscus singleyanus* (Pilsbry, 1890)			
Family:	Discidae			
	Discus Fitzinger, 1833			
	perspectivus (M. von Mühlfeld, 1816)	B	M	VU
	rotundatus (O. F. Müller, 1774)	B	M	LC
	ruderatus (A. Férussac, 1821)	B	M	NT
Superfamily:	Vitrinoidea			
Family:	Gastrodontidae			
	Zonitoides Lehmann, 1862			
	nitidus (O. F. Müller, 1774)	B	M	LC
Family:	Euconulidae			
	Euconulus Reinhardt, 1833			
	alderi (Gray, 1840)	B	M	VU
	fulvus (O. F. Müller, 1774)	B	M	LC
Family:	Vitrinidae			
	Vitrina Draparnaud, 1801			
	pellucida (O. F. Müller, 1774)	B	M	LC
	Eucobresia H. B. Baker, 1929			
	diaphana (Draparnaud, 1805)	B(LC)	M(NT)	LC
	nivalis (Dumont et Mortillet, 1854)	B(EN)	M(VU)	EN
	Semilimax Agassiz, 1845			
	kotulae (Westerlund, 1883)	B	M	VU
	semilimax (J. Férussac, 1802)	B	M	LC
Family:	Zonitidae			
Subfamily:	Vitreinae			
	Vitrea Fitzinger, 1833			
	contracta (Westerlund, 1871)	B	M	LC
	crystallina (O. F. Müller, 1774)	B	M	LC
	diaphana (Studer, 1820)	B	M	NT
	subrimata (Reinhardt, 1871)	B	M	VU
	transsylvanica (Clessin, 1877)	B(CR)	M(EN)	EN
Subfamily:	Zonitinae			
	Aegopis Fitzinger, 1833			
	verticillus (Lamarck, 1822)	B	M	VU
	Aegopinella Lindholm, 1927			
	epipedostoma (Fagot, 1879) 28)		M	NT
	minor (Stabile, 1864)	B	M	LC
	nitens (Michaud, 1831)	B	M	LC
	nitidula (Draparnaud, 1805)	B(NT)	M(VU)	NT
	pura (Alder, 1830)	B	M	LC
	Perpolita H. B. Baker, 1928			
	hammonis (Ström, 1765)	B	M	LC
	= *P. radiatula* (Alder, 1830)			
	petronella (L. Pfeiffer, 1853)	B(EN)	M(CR)	EN
Subfamily:	Oxychilinae			
	Oxychilus Fitzinger, 1833			
	alliarius (Miller, 1822) 46)	B		NE
	cellarius (O. F. Müller, 1774)	B	M	LC
	depressus (Sterki, 1880)	B	M	NT
	draparnaudi (Beck, 1837)	B	M	LC
	glaber (Rossmässler, 1835)	B	M	NT
	inopinatus (Uličný, 1887)	B(NT)	M(LC)	NT

	mortilleti (L. Pfeiffer, 1859) 27)	**B**		CR
	= *O. villae* (Strobel, 1853)			
Family:	Daudebardiidae			
	Daudebardia Hartmann, 1821			
	brevipes (Draparnaud, 1805)	**B(EN)**	**M(VU)**	EN
	rufa (Draparnaud, 1805)	**B**	**M**	NT
Family:	Milacidae			
	Tandonia Lessona et Pollonera, 1882			
	budapestensis (Hazay, 1881)	B	**M**	LC
	= *Milax gracilis* (Leydig, 1876)			
	rustica (Millet, 1843)	B		NT
Superfamily:	Limacoidea			
Family:	Limacidae			
	Bielzia Clessin, 1887			
	coerulans (M. Bielz, 1851)		M	VU
	Limax Linnaeus, 1758			
	cinereoniger Wolf, 1803	B	M	LC
	maximus Linnaeus, 1758	B	M	LC
	Limacus Lehmann, 1864			
	flavus (Linnaeus, 1758) 6)	B	M	LC
	Malacolimax Malm, 1868			
	tenellus (O. F. Müller, 1774)	B	M	LC
	Lehmannia Heynemann, 1863			
	macroflagellata Grossu et Lupu, 1962 31)	B	M	NT
	marginata (O. F. Müller, 1774)	B	M	LC
	nyctelia (Bourguignat, 1861) 25)		M	EN
Family:	Agriolimacidae			
	Deroceras Rafinesque, 1820			
	agreste (Linnaeus, 1758)	B	M	LC
	laeve (O. F. Müller, 1774)	B	M	LC
	praecox Wiktor, 1966 29)	B	M	NT
	reticulatum (O. F. Müller, 1774)	B	M	LC
	rodnae Grossu et Lupu, 1965 30)	B	M	LC
	sturanyi (Simroth, 1894) 30)	B	M	LC
	turcicum (Simroth, 1894) 51)	B	M	NE
Family:	Boettgerillidae			
	Boettgerilla Simroth, 1910			
	pallens Simroth, 1912 2) 33)	B	M	LC
	= *B. vermiformis* Wiktor, 1959			
Superfamily:	Arionoidea			
Family:	Arionidae			
	Arion A. Férussac, 1819			
	circumscriptus Johnston, 1828	B(LC)	M(NT)	NT
	distinctus Mabille, 1868	B	M	LC
	= *A. hortensis* Férussac, *1819 part.*			
	fasciatus (Nilsson, 1823) 41)	B	M	LC
	intermedius (Normand, 1852)	B(NT)	M(VU)	NT
	lusitanicus Mabille, 1868 2) 35)	B	M	LC
	rufus (Linnaeus, 1758)	B	M	LC
	silvaticus Lohmander, 1937 41)	B	M	LC
	subfuscus (Draparnaud, 1805)	B	M	LC
	= *A. fuscus* (O. F. Müller, 1774)			

Superfamily:	Helicoidea			
Family:	Bradybaenidae			
	Fruticicola Held, 1838			
	fruticum (O. F. Müller, 1774)	B	M	LC
Family:	Hygromiidae			
Subfamily:	Helicodontinae			
	Helicodonta A. Férussac, 1821			
	obvoluta (O. F. Müller, 1774)	B	M	NT
Subfamily:	Monachinae			
	Euomphalia Westerlund, 1889			
	strigella (Draparnaud, 1801)	B	M	LC
	Monacha Fitzinger, 1833			
	cartusiana (O. F. Müller, 1774)[2] [6]	B(NE)	M(NT)	NT
Subfamily:	Hygromiinae			
	Trichia Hartmann, 1840			
	hispida (Linnaeus, 1758)	B	M	LC
	sericea (Draparnaud, 1801)	B	M	LC
	villosula (Rossmässler, 1838)		M	VU
	Plicuteria Schileyko, 1978			
	lubomirskii (Ślósarskii, 1881)	B(VU)	M(LC)	NT
	Petasina Beck, 1847			
	edentula (Draparnaud, 1805)[43]	B		EN
	unidentata (Draparnaud, 1805)	B	M	NT
	Helicopsis Fitzinger, 1833			
	striata (O. F. Müller, 1774)	B(CR)	M(EX?)	CR
	Candidula Kobelt, 1871			
	soosiana (J. Wagner, 1933)[7]		M	CR
	unifasciata (Poiret, 1801)	B	M	CR
	Helicella A. Férussac, 1821			
	itala (Linnaeus, 1758)	B		EN
	Xerolenta Monterosato, 1892			
	obvia (Menke, 1828)	B	M	LC
	= *Helicella candicans* (L. Pfeiffer, 1841)			
	Cernuella Schlüter, 1838			
	neglecta (Draparnaud, 1805)	B		NT
	Perforatella Schlüter, 1838			
	bidentata (Gmelin, 1791)	B	M	NT
	= *P. bidens* (Chemnitz, 1786)			
	Monachoides Gude et Woodward, 1921			
	incarnatus (O. F. Müller, 1774)	B	M	LC
	vicinus (Rossmässler, 1842)	B(NT)	M(LC)	NT
	Pseudotrichia Likharev, 1949			
	rubiginosa (Rossmässler, 1838)[20]	B	M	VU
	Urticicola Lindholm, 1927			
	umbrosus (C. Pfeiffer, 1828)	B	M	LC
Family:	Helicidae			
Subfamily:	Ariantinae			
	Arianta Turton, 1831			
	arbustorum (Linnaeus, 1758)	B	M	LC
	Helicigona A. Férussac, 1821			
	lapicida (Linnaeus, 1758)	B	M	LC
	Faustina Kobelt, 1904			
	faustina (Rossmässler, 1835)	B(VU)	M(NT)	VU
	Isognomostoma Fitzinger, 1833			
	isognomostomos (Schröter, 1784)	B	M	LC
	= *I. personatum* (Lamarck, 1792)			

	Causa Schileyko, 1971			
	holosericea (Studer, 1820)	B	M	NT
Subfamily:	Helicinae			
	Cepaea Held, 1838			
	hortensis (O. F. Müller, 1774)	B	M	LC
	nemoralis (Linnaeus, 1758)	B(LC)	M(NE)	LC
	vindobonensis (A. Férussac, 1821)	B	M	NT
	Helix Linnaeus, 1758			
	pomatia Linnaeus, 1758	B	M	LC
Class:	Bivalvia			
Subclass:	Palaeoheterodonta			
Order:	Unionoida			
Superfamily:	Unionoidea			
Family:	Margaritiferidae			
	Margaritifera Schuhmacher, 1816			
	margaritifera (Linnaeus, 1758)	B	M	CR
Family:	Unionidae			
Subfamily:	Unioninae			
	Unio Philipsson, 1788			
	crassus Philipsson, 1788	B	M	EN
	pictorum (Linnaeus, 1758)	B	M	LC
	tumidus Philipsson, 1788	B	M	VU
Subfamily:	Anodontinae			
	Anodonta Lamarck, 1799			
	anatina (Linnaeus, 1758)	B	M	LC
	cygnea (Linnaeus, 1758)	B	M	VU
	Pseudanodonta Bourguignat, 1877			
	complanata (Rossmässler, 1835)	B(EN)	M(CR)	EN
	Sinanodonta Modell, 1945			
	woodiana (Lea, 1834)[2) 10)]		M	NE
Subclass:	Heterodonta			
Order:	Veneroida			
Superfamily:	Sphaerioidea			
Family:	Corbiculidae			
	Corbicula M. von Mühlfeld, 1811			
	fluminea (O. F. Müller, 1774)[2) 11)]	B		NE
Family:	Sphaeriidae			
	Sphaerium Scopoli, 1777			
	corneum (Linnaeus, 1758)	B	M	LC
	rivicola (Lamarck, 1818)	B	M	EN
	Musculium Link, 1807			
	lacustre (O. F. Müller, 1774)	B	M	NT
	Pisidium C. Pfeiffer, 1821			
	amnicum (O. F. Müller, 1774)	B(EN)	M(CR)	EN
	casertanum (Poli, 1791)	B	M	LC
	henslowanum (Sheppard, 1823)	B	M	LC
	hibernicum Westerlund, 1894	B(EN)	M(CR)	EN
	milium Held, 1836	B	M	VU
	moitessierianum Paladilhe, 1866[18)]	B	M	EN
	nitidum Jenyns, 1832	B	M	LC
	obtusale (Lamarck, 1818)	B(LC)	M(NT)	LC
	personatum Malm, 1855	B	M	LC
	pseudosphaerium Favre, 1927[18)]	B	M	CR
	subtruncatum Malm, 1855	B	M	LC
	supinum A. Schmidt, 1851	B	M	VU
	tenuilineatum Stelfox, 1918	B	M	CR

Superfamily:	Dreissenoidea			
Family:	Dreissenidae			
	Dreissena van Beneden, 1835			
	polymorpha (Pallas, 1771) 2) 8)	B	M	LC

1) missing or extinct species

2) non-native species

3) this taxon was subdivided into more species (in the Czech Republic *Stagnicola turricula*, *S. occulta*, *S. fuscus*, *S. corvus*; one further species, i.e. *S. palustris* s. str. has not been found yet in the Czech Republic)

4) problematic taxon (compare Jackiewicz 1993 versus Glöer & Meier-Brook 1994, Fechter & Falkner 1990 and Turner et al. 1998)

5) problematic form

6) eusynantroph

7) taxonomic position of this species is still problematic, some authors do not adopt it and consider this species synonymous with *Candidula unifasciata*

8) in southern Moravia probably native

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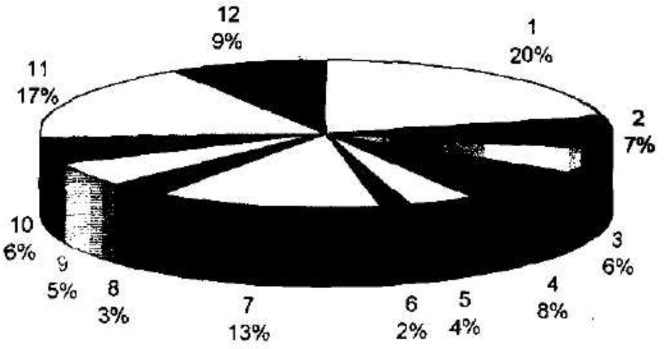

Fig. 1. The proportion of ecological groups. Ecological groups accorging to (Ložek 1964): 1 – closed forest, 2 – predominantly forest, 3 – humid forest, 4 – steppe – xerothermic habitats, 5 – open grounds in general, 6 – woodland and grassland predominantly dry, 7 – woodland and grassland mesic or different, 8 – humid habitats, 9 – wetlands banks, 10 – small temporary waters, 11 – stagnant or moderately flowing waters, 12 – flowing waters.

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References are given for all species firstly recorded in the Czech Republic after 1956. In view of the fact that the last list of Czech molluscs was published in a book dealing with Quarternary molluscs, where slugs were not commented (Ložek 1964), we adopted the key of Czechoslovak molluscs (Ložek 1956) as the more suitable baseline.

The territory of the Czech Republic was divided into two parts (Bohemia and Moravia including the Czech part of Silesia) on the basis of historical development. This subdivision has lost its administrative role but is traditionally used in biological research. Bohemia is constituted by a single biogeographical subprovince (Hercynicum) whereas Moravia is constituted by four subprovinces (Polonicum, Carpathicum, Panonicum and Hercynicum). This is the main reason for the different distribution of some species.

The classification is according to Turner et al. (1998) with small modifications based on new information. B – species occurs in Bohemia; M – species occurs in Moravia and Silesia; the Red List categories are given in brackets separately for Bohemia and Moravia where the status in one part of the country is different from the status in the total Czech Republic (given in the last column): extinct – EX, critically endangered – CR, endangered – EN, vulnerable – VU, near threatened – NT, least concern – LC, not evaluated – NE (IUCN 1994).

RESULTS

Molluscs of former Czechoslovakia were divided into 12 groups on the basis of their ecological requirements (Ložek 1964). These subdivisions were proposed for paleontological use, but they are also successfully used for the ecological division of recent molluscs. Most freshwater molluscs in the Czech Republic belong to group 11; i. e. species of stagnant or moderately flowing waters (Fig. 1). The species of small temporary waters (group 10) and of flowing waters (group 12) are represented to a lesser extent. Forest species of group 1, group 2 – mostly forest species inhabiting other shaded localities, and group 3 – hygrophilous forest species are the most successful ecological types corresponding to the potential climax vegetation in the Czech Republic. Man has substantially changed Central European landscape (habitats). The rather high percentage (13%) of eurytopic species (group 7) represents species that have adapted to these changes quite well.

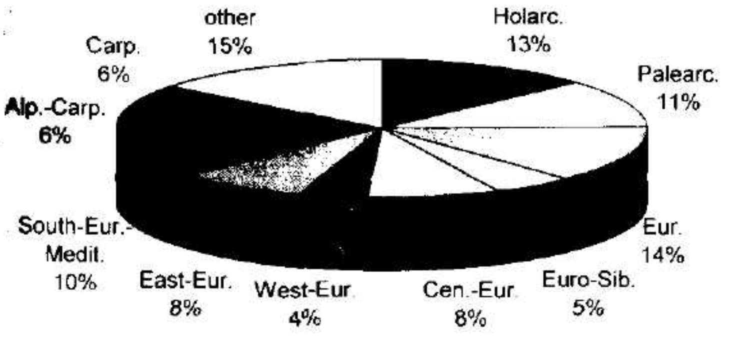

Fig. 2. The proportion of zoogeographical groups. Zoogeographical distribution according to (Alexandrowicz 1987, Ložek 1956).

Species of open habitats (groups 5 and 6) exploit man-made habitats or survive in extreme habitats such as rocks or rocky steps (group 4) – they account for 14% of the Czech mollusc fauna. The smallest groups are that of moderately moisture loving (group 8) and strictly hygrophilous species (group 9), together making up for 8% of our fauna.

The majority of Czech mollusc species (57%) have a relatively small range of distribution within Europe (Fig. 2). Species with South-Euroupean and Mediterranean ranges are the most frequent group (10%). But there are also important representatives of Central European (8%), East European (8%), Alpine-Carpathian (6%) and Carpathian (6%) species. These ranges show the main refugias of our fauna. Wide species ranges (Holarctic, Palaearctic and Europe) are represented to a lesser extent (43%). These types of distribution are typical of aquatic molluscs.

The Red Lists of the Czech Republic's molluscs which were previously published by Beran (1998) and Juřičková (1998) using IUCN categories has been divided up into regional Red Lists for Bohemia and Moravia. The shares of species assigned to the individual categories are shown in Fig. 3. The Red List includes 94 species assigned to the first four categories, i.e. 40% of all species recorded. This number is an alarming proof of the deterioration of the broad variety of natural habitats of our snails.

The following species were reported from the Czech Republic in the past, but collection specimens weren't preserved and the very existence of these species is consequently doubtful. This applies to: *Malacolimax kostali* Babor, 1893, *Arion vejdovskyi* Babor et Kostal, 1893 (Uličný 1892–1895). Hudec (1970) mentions the species *Deroceras subagreste* (Simroth, 1893) which was never found again. In view of the present range of this species (Wiktor 2000), the occurrence of this slug is very improbable. A single find of the non-native species *Vitrinobrachium breve* (A. Férus-

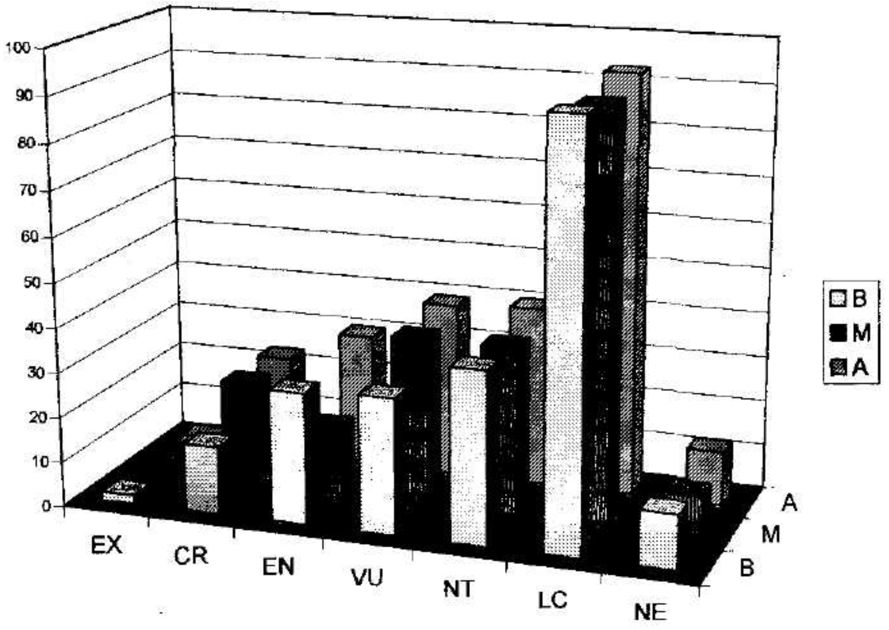

Fig. 3. The shares of species assigned to Red List categories B – Bohemia, M – Moravia, A – all the Czech Republic; EX – extinct, CR – critically endangered, EN – endangered, VU – vulnerable, NT – near threatened, LC – least concern, NE – not evaluated (IUCN 1994).

sac, 1821) has been reported (Flasar 1971), but it is now probably extinct on the single locality given (Flasar 1998). A single find of subfossil shells of *Sphaerium solidum* (Normand, 1844) was published by Petrbok (1957). The present occurrence of this sphaeriid clam in the Czech Republic is very unlikely. Several occurrences of the pill clam *Pisidium pulchellum* (Jenyns, 1832) were reported in the past, but detailed revision (Brabenec 1973) has shown, that in all cases the material was determinated incorrectly.

Physella heterostropha (Say, 1817) and *Deroceras panormitanum* (Lessona et Pollonera, 1882) probably live in the territory of the Czech Republic, but their occurrence has not been documented yet. These are non-native species found in bordering countries. The lymnaeid snail *Pseudosuccinea columella* (Say, 1824) was found in natural streams (Mácha 1971), but these specimens were flushed by effluent water from waste water plants. It is a common species of warmed-up greenhouse pools, aquariums etc. The survival of this species in nature during the colder parts of the year is unlikely. Records of the planorbid snail *Helisoma* cf. *trivolvis* (Say, 1817) in natural habitats are a similar case; this species is common in aquariums. The land snail *Zonitoides arboreus* (Say, 1816) is also common in greenhouses. No survival of the winter period by individuals introduced outdoors with soil has been observed.

237 species of molluscs have been recorded in the Czech Republic (incl. 75 fresh-water species): 211 species of the class Gastropoda (16 species of the subclass Prosobranchia, 195 species of the subclass Pulmonata) and 26 species of the class Bivalvia (8 species of the subclass Palaeoheterodonta and 18 species of the subclass Heterodonta).

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Lanzatus somalicus gen. et sp. n. (Scorpiones: Buthidae) from Somalia

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Abstract. *Lanzatus* gen. n. (type species *L. somalicus* sp. n.) from Somalia is related to cosmotropical genus *Isometrus* Ehrenberg, 1828 and to the Central Asian (Kazakhstan, Turkmenistan, Uzbekistan) genera *Anomalobuthus* Kraepelin, 1900 and *Pectinibuthus* Fet, 1987. It differs from *Isometrus* in having telson without a subaculear tooth or tubercle. From *Pectinibuthus* and *Anomalobuthus* it differs in having tibia and tarsomere of legs I–III with setae not arranged into a bristlecomb.

Taxonomy, description, key, distribution, Scorpiones, Buthidae, *Lanzatus somalicus* gen. et sp. n., Afrotropical region

Lanzatus gen. n.
(Figs 1–7, Tab. 1)

TYPE SPECIES. *Lanzatus somalicus* sp. n. (by monotypy).
ETYMOLOGY. Masculinum, after Prof. Benedetto Lanza, who collected the type specimen; Vachon's unpublished name (see below).
DIAGNOSIS. The basic trichobothrial pattern is beta (Fig. 5 and Sissom 1990: 70, fig. 3.3); third and fourth legs without tibial spurs; sternum subtriangular; tibia and tarsomere of legs I–III with setae not arranged into a bristlecomb (Fig. 7 and Sissom 1990: 92, fig. 3.17.M); pedipalp patella with seven external (Fig. 3), five dorsal, and one internal (Fig. 4) trichobothria; telson without a subaculear tooth or tubercle (Fig. 1).

The new genus is also characterized by seven diagonal rows of granules on the movable fingers of pedipalps (Fig. 6); three pairs of lateral eyes; prolonged telson (Fig. 1); smooth mesosomal and metasomal segments without keels; and other features included in the description of *Lanzatus somalicus* sp. n. below.
AFFINITIES. Inclusion in Sissom's (1990: 96) key to genera of the family Buthidae is as follows:

Tibia and tarsomere of legs I–III with setae not arranged into a bristlecomb:
1. Telson with a subaculear tooth or tubercle. .... *Isometrus* Ehrenberg, 1828
– Telson without a subaculear tooth or tubercle. .... *Lanzatus* gen. n.

Lanzatus gen. n. is closest to the genera *Pectinibuthus* and *Anomalobuthus*, from which it is differentiated in Sissom's key by having setae on tibia and tarsomere of legs I–III not arranged into a bristlecomb (Fig. 7 and Sissom 1990: 92, fig. 3.17.M). Further differences are included in the following key:

1 Pedipalp femur lacking trichobothrium d_2, patella lacking d_2, and chela lacking esb, Esb, and Eb_3; pectines with more than 35 teeth. .... *Pectinibuthus* Fet, 1987
– Pedipalp femur, patella, and chela with number of trichobothria characteristic of the family Buthidae; pectines with less than 35 teeth. 2

Table 1. Measurements in millimeters of *Lanzatus somalicus* gen. et sp. n.

		Lanzatus somalicus gen. et sp. n. male, holotype
Total	length	27.6
Carapace	length	2.7
	width	2.8
Metasoma	length	17.6
segment I	length	2.3
	width	1.6
segment II	length	2.7
	width	1.4
segment III	length	2.9
	width	1.4
segment IV	length	3.2
	width	1.2
segment V	length	3.5
	width	1.2
telson	length	2.6
Pedipalp		
femur	length	1.9
	width	0.6
patella	length	2.5
	width	0.9
tibia	*length*	3.0
	width	0.5
finger mov.	length	2.0
Pectinal teeth		20:20

2 Trichobothrium eb on the chela of pedipalps situated between trichobothria Et and esb (fig. 37 in Vachon 1974: 908). Movable finger of pedipalps with rows of granules which do not form diagonal rows (fig. 7 in Kraepelin 1900: 9). .... *Anomalobuthus* Kraepelin, 1900

– Trichobothrium eb on the chela of pedipalps situated between trichobothria Et and Esb (Fig. 2). Movable finger of pedipalps with rows of granules which form diagonal rows (Fig. 6). .... *Lanzatus* gen. n.

Lanzatus somalicus **sp. n.**

(Figs 1–7, Table 1)

TYPE MATERIAL. Somalia, Gesëra's mangrove, 01° 57' N – 45° 11' E, 2 m a. s. l., VIII.1975, SBS (Spedizione Biologica Somalia), 1 male (holotype [MZUF No. 540]); Lesñmma, 04° 30' N – 45° 44' E, 268 m a. s. l., 3.VIII.1969, *1 immature male (paratype), SBS, leg. B. Lanza under a stone in a rainy period. Both type specimens are preserved* in alcohol. The holotype is deposited in the Museo Zoologico de "La Specola", Firenze, Italy, and the paratype is in the author's collection. These specimens were examined in 1976 by Max Vachon, who appended to them numbers VA 1396 and VA 1493 and the name "*Lanzatus* genre n.", which he has never published.

TYPE LOCALITY. Somalia, Gesëra's mangrove, 01° 57' N, 45° 11' E.

ETYMOLOGY. After the country of occurrence.

DIAGNOSIS. The length is 27.6 mm in the male holotype and 19.7 mm in the juvenile male paratype. Measurements of the carapace, telson, segments of metasoma and pedipalps, and numbers of pectinal teeth are given in Table 1. There are 20 pectinal teeth in the holotype. The paratype has 19 pectinal teeth. For the position and distribution of trichobothria on the pedipalps see Figs 2–5.

The color is uniformly yellow to yellowish brown with black only around the eyes and in the holotype with inconspicuous dark longitudinal bands on the mesosomal segments, situated where most other buthid genera have keels. The juvenile paratype has the fifth metasomal segment marbled grayish black.

The femur and patella of pedipalps bear inconspicuous dorsal keels. There are no other keels on the pedipalp, carapace, mesosoma, and metasoma.

The ventral surface of all mesosomal segments is smooth, without keels and granules. The metasomal segments are smooth, without keels, and have rounded edges. The dorsal surface of the

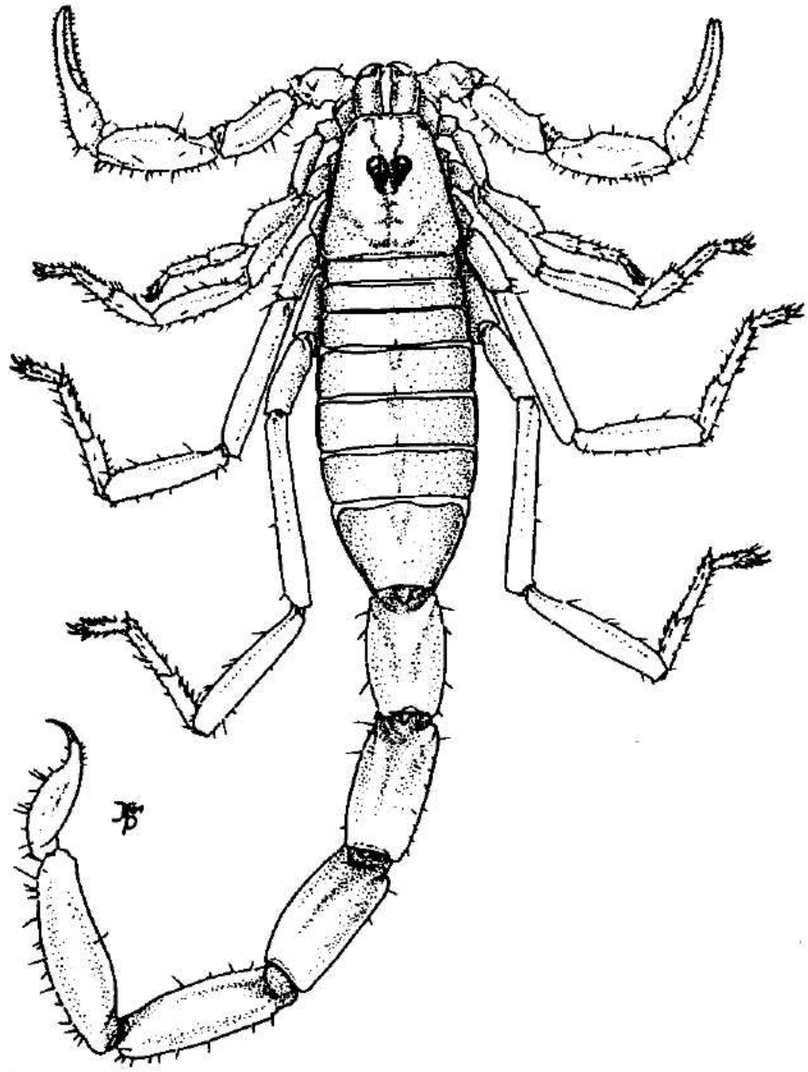
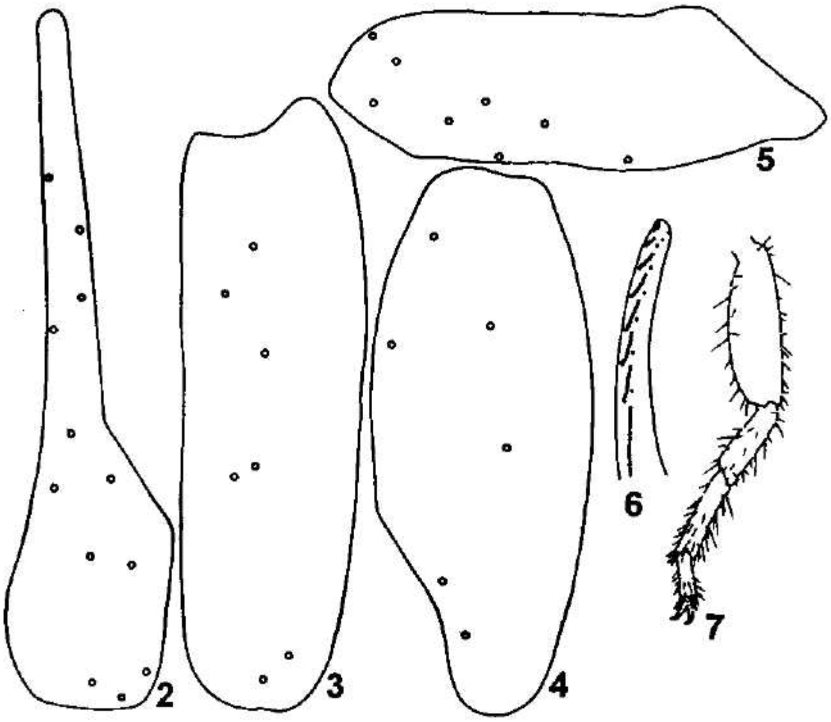


Fig. 1. *Lanzatus somalicus* gen. et sp. n., male holotype. Dorsal view.



Figs 2–7. *Lanzatus somalicus* gen. et sp. n., male holotype. Fig. 2. Tibia, dorsal and external views. Fig. 3. Patella, external view. Fig. 4 Patella, dorsal view.. Fig. 5. Femur, dorsal view. Fig. 6. Movable finger. Fig. 7. Second leg.

first to fourth metasomal segments bears an inconspicuous longitudinal groove. The fourth and fifth metasomal segments are densely and very finely granulated. The telson is very slender, smooth, and lacks a subaculear tooth or tubercle (Fig. 1).

Affinities. See generic affinities.

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Trematodes of owls (Aves: Strigiformes) in the Czech Republic

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Abstract. In the years 1962 to 2000 were examined 189 owls of 8 species (*Asio otus* 87, *Strix aluco* 40, *Tyto alba* 27, *Bubo bubo* 22, *Athene noctua* 6, *Asio flammea* 4, *Otus scops* 2, *Strix uralensis* 1). Were found 8 species of trematodes (*Echinostoma revolutum* (Froehlich, 1802), *Echinoparyphium recurvatum* (Linstow, 1873), *Brachylecithum strigis* (Yamaguti, 1939), *Brachylaime fuscatus* (Rudolphi, 1819), *Leucochloridium perturbatum* Pojmanska, 1969, *Strigea falconis* Szidat, 1928, *S. strigis* (Schrank, 1788), *Neodiplostomum canaliculatum* (Nicoll, 1914). First time in the Europe found *Brachylecithum strigis*, first time in the Czech Republic found *Neodiplostomum canaliculatum*. New hosts found for *Echinostoma revolutum* – *Bubo bubo* and *Strix aluco*, for *Echinoparyphium recurvatum* – *Strix aluco*, for *Brachylaime fuscatus* and *Leucochloridium perturbatum* – *Asio otus*.

Distribution, Trematodes, owls, Palaearctic region

INTRODUCTION

Nobody delt with research of trematodes in owl in the Czech Republic, because of their very poor species composition. This is caused by two facts: most of owls belong among no migratory birds, this is why there is no occurrence of trematodes brought from winter places. The other factor is composition of food. This is in our owls monotonous consisting mostly of small mammals or birds. In Central European very rarely there appear amphibians, insects and earthworms (Hudec 1983). The most frequent trematodes are species of the families Strigeidae and Diplostomatidae, developing stages of which parasite in birds or small mammals (Yamaguti 1971).

The only work dealing with helmints of birds of prey and owls in the Czech Republic is the one by Tenora & Lusk (1960). Other authors present in their works just accidental discoveries (Ryšavý 1957, Škarda 1964). Even in the world literature we find little of works dealing with this problem. Thibithenko (1958) studied helmints of *Bubo bubo* in Kyrgyzstan, Ewald et al. (1993) of *Strix aluco* in the United Kingdom. Majority of authors studied helmints of owls during the research of helmints birds of prey. It was Furmaga (1958) in Poland, Iskova et al. (1980) in Ukraine, Kharchenko et al. (1980) in Russia , Lüthgen (1978) in Germany. We find a lot of data in monographs about trematodes (Skryabin 1949–1978, Bykhovskaya-Pavlovskaya 1962, Dubois 1969–1970, Yamaguti 1971, Chiriac & Udrescu 1973, Edelenyi 1974). But, make use of some older works is limited. There are no descriptions and pictures of found species there and this is why it is frequently impossible to find out, with which species the authors worked.

MATERIALS AND METHODS

In the years 1962 to 2000 were examined with the method of complete helminthological dissection 189 owls of 8 species, *Asio otus* (Linnaeus, 1758) 87 spec., *Strix aluco* (Linnaeus, 1858) 40 spec., *Tyto alba* (Scopoli, 1769) 27 spec., *Bubo bubo* (Linnaeus, 1858) 22 spec., *Athene noctua* (Scopoli, 1769) 6 spec., *Asio flammeus* (Pontoppidan, 1763) 4 spec., *Otus scops* (Linnaeus, 1858) 2 spec., *Strix uralensis* (Pallas, 1771) 1 spec. The examined birds were died birds supplied for preparation into museum collections and birds sent to the Station for rescue of animals in Bartošovice na Moravě, which died from their wounds or should have been killed for their incurable injuries. The birds comes from many localitions of the whole Czech Republic

Trematodes were fixed by 70 % alcohol, stained by borax-carmine, transferred through alcohol series to xylene and mounted in Canadian balsam. Documentary material is stored in collections of Moravian ornithological station of the Komenský museum in Přerov. All the given data are in millimetres.

SURVEY OF SPECIES

Echinostoma revolutum (Froehlich, 1802)

(Fig. 1)

Hosts. *Bubo bubo, Strix aluco.*
Localization. Large intestine.
Intensity of invasion. *Bubo bubo* 1 spec., *Strix aluco* 2.
Abundance. *Bubo bubo* 1.0 spec., *Strix aluco* 2.0.
Prevalence. *Bubo bubo* 5.0 %, *Strix aluco* 4.2 %.
Localities. May 15, 1995 Přerov code of mapping square 6570; September 23, 1996 Jiříkov, 6169.
Geographic distribution. Cosmopolitan.

It belongs among the most frequent trematodes in birds. Found in many birds all over the world (Yamaguti 1971). Findings in the Czech Republic summarized Sitko (1993). In Russia found Bykhovskaya-Pavlovskaya (1962) in *Strix uralensis*. *Bubo bubo* and *Strix aluco* are new hosts of this species. Juvenile specimens without eggs found in *S. aluco*.

Description. The described and depicted specimen was found in *Bubo bubo* from Jiříkov (Fig. 1A, B). Length of the body 5.260, width 0.80. Front half of the body covered with relatively large angular spines measuring 0.008. Head collar covered with 37 spines arranged in two rows. Dorsal spines measuring 0.076×0.016, oral spines 0.084×0.016, aboral spines 0.80×0.016. Oral sucker is terminal measuring 0.180×0.192. Ventral sucker is much larger. It is situated in the first fourth of the body measuring 0.636×0.588. Ratio of the suckers amounts 1:3.29. Praepharynx is very short measuring 0.043. Pharynx is muscular, oval, measuring 0.160×0.168. Oesophagus is 0.240 long and, in front of the ventral sucker, is divided into two intestinal branches reaching up to the end of the

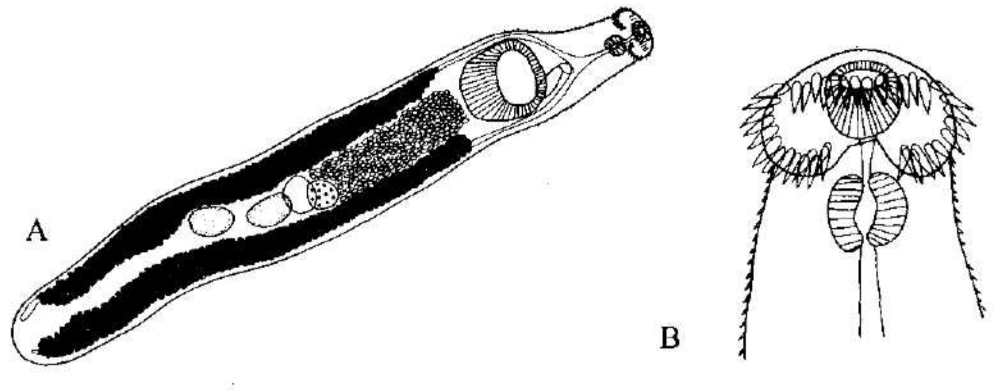


Fig. 1. *Echinostoma revolutum* (Froehlich) (*Bubo bubo*, Jiříkov, 23-9-1996); A – ventral view, B – head colar.

body. Long oval bursa cirri is situated in the space between intestinal bifurcation and ventral sucker sizing 0.386×0.241. Testes are long oval, full-edged, situated in the rear half of the body in the longitudinal axis one after another. The front one is a little smaller than the rear one. The front one measuring 0.336×0.241, the rear one 0.360×0.246. Ovarium is of oval shape, it is situated in front of the testicles measuring 0.252×0.228. Mehlis gland measuring 0.210×0.240 is situated behind it. Vitellaria are composed of numerous follicles lying along the sides of the body in the space *between the lower edge of the ventral sucker and the end of the body covering intestinal branches.* Uterus with many eggs is situated in the region between the front testes and the ventral sucker. The eggs are ranging in size 0.116–0.119 (0.118)×0.062–0.065 (0.064).

Echinopryphium recurvatum **(Linstow, 1873)**

(Fig. 2)

Host. Strix aluco.
Localization. Small intestine.
Intensity of invasion. 1–8 spec.
Abundance. 3.6 spec.
Prevalence. 8.3 %.
Localities. June 15, 1967 Jindřichův Hradec, 6855; May 15, 1995 Přerov, 6570.
Geographic distribution. Cosmopolitan.

It is a frequent trematode in birds of orders Anseriformes and Charadriiformes found in all the world around (Yamaguti 1971). Exceptionally found in Falconiformes Oschmarin (1956) as well. In owls, it is referred to in Russia by Bykhovskaya-Pavlovskaya (1962) in *Strix uralensis*. Sitko (1993) summarizes in his work findings in the Czech Republic. *S. aluco* is a new host of the species.
Description. (11 specimens measured, data in brackets are averages, depicted specimens are from Jindřichův Hradec, Fig. 2A, B). Middle-sized trematodes are 2.686–4.0 (3.121) long, 0.40–0.686

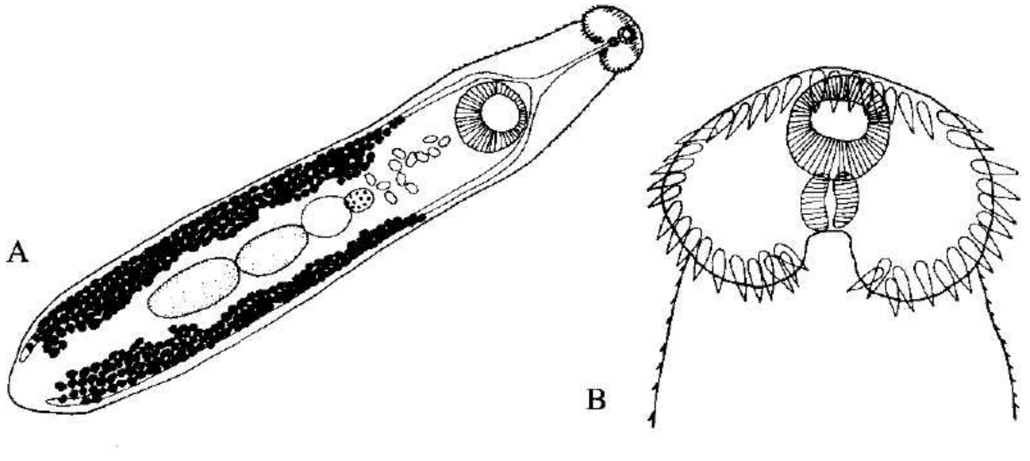


Fig. 2. *Echinoparyphium recurvatum* (Linstow) (*Strix aluco*, Jindřichův Hradec, 15-6-1967); A – ventral view, B – head collar.

(0.514) wide. Front part of the body up to the ventral sucker is covered by numerous small spines 0.011–0.016 (0.015) long, 0.005 wide. Head collar is of kidney shape, 0.198–0.343 (0.247) long, 0.180–0.30 (0.250) wide. It is armed with 45 spines arranged in two rows. Dorsal spines measuring 0.054–0.062 (0.059)×0.011–0.016 (0.015), oral ones 0.059–0.068 (0.064)×0.011–0.016 (0.015). Oral sucker is terminal, of round shape, measuring 0.090–0.120 (0.103)×0.084–0.120 (0.093). Praepharynx is very short, pharynx of roundl or oval shape, 0.054–0.108 (0.084) long, 0.040–0.094 (0.062) wide. Oesophagus is 0.210–0.605 long and is divided into two intestinal branches reaching up the the end of the body. Ventral sucker situated in the first third of the body is much larger than the oral sucker. It measures 0.270–0.450 (0.315)×0.240–0.360 (0.291). Ratio of the suckers 1:2.7–3.9 (3.1). Bursa cirri is situated near the upper edge of the ventral sucker, is of oval shape, 0.132–0.360 (0.270) long, 0.120–0.180 (0.143) wide. Cirrus ranging 0.270–0.660 (0.360). Testes are full-edged, long oval, situated one after another. The rear one is regularly larger than the front one. The front testicles is 0.252–0.432 (0.314) long, 0.132–0.240 (0.178) wide. The rear testes is 0.288–0.480 (0.361) long, 0.132–0.234 (0.178) wide. Round or oval shaped ovarium lies in the middle of the body and is 0.102–0.192 (0.135) long, 0.090–0.150 (0.143) wide. Mehlis gland 0.162–0.240 (0.201) long and 0.108–0.210 (0.145) wide is situated between ovarium and front testes. Vitellaria are situated along the sides of the body reaching with their front parts in front of ovarium. They often fill in all the room behind the rear testicle. Uterus is relatively short and contains a small number of eggs measuring 0.090–0.094 (0.093)×0.054–0.059 (0.057).

Brachylecithum strigis **(Yamaguti, 1939)**

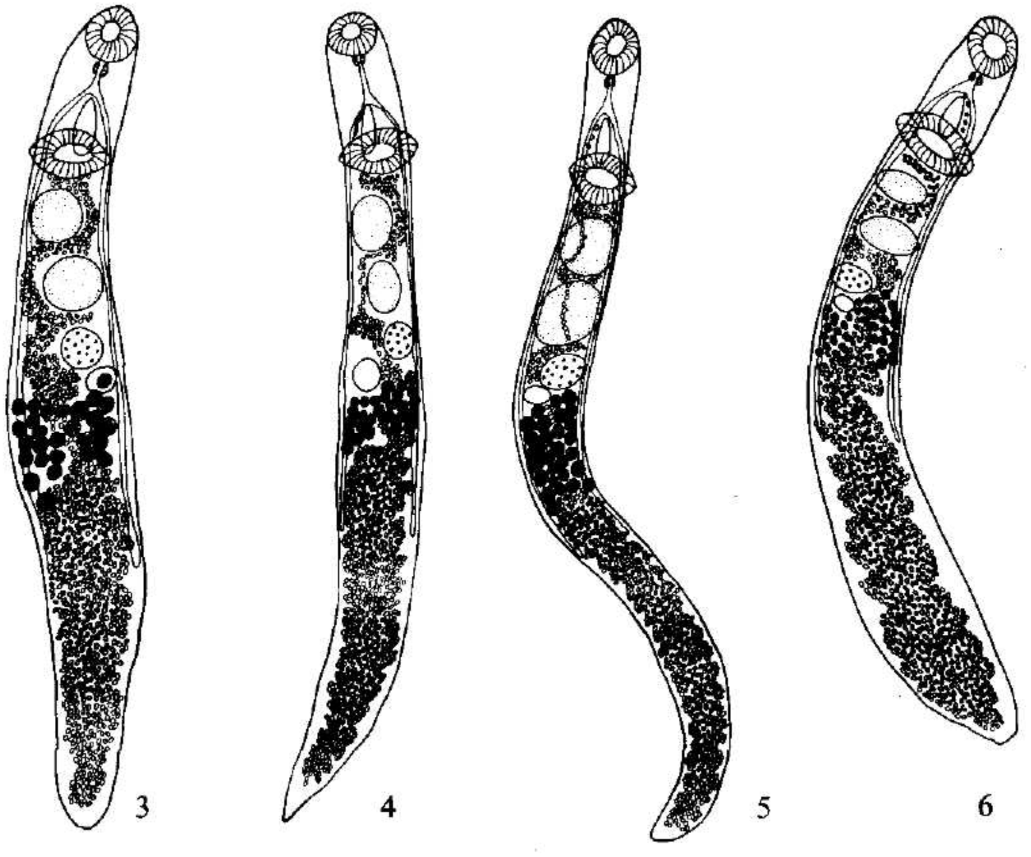
(Figs 3–6)

Host. *Otus scops.*
Localisation. Gall bladder, liver.
Intensity of invasion. 152 spec.
Locality. June 3,1999 Vitonice, 6572.
Geographic distribution. Holarctic.

Specific parasite of owls, described in *Strix uralensis* from Japan (Yamaguti, 1971). It was found from Primorsky Region in Far East by Oschmarin (1963) in the sam host and in *Bubo bubo* and *Accipiter nisus*. *Brachylecithum strigis* is found for the first time in Europe, *Otus scops* is a new host. The trematodes described by us are of smaller size than presented in type material. The difference is caused by significantly smaller of the new host and by high intensity of infection, when trematodes regulary reach smaller sizes (Figs 3–6).

Description. (mesaured 30 specimens) Body of long oval shape, exeptionally threadlike. Length 3.318–4.891(3.872± 0.333), width 0.400–0.571(0.454± 0.040), ratio 7.40–10.87 (8.53± 1.01). Praeacetabular part is long 0.029–0.686 (0.565± 0.079), postacetabular part is long 2.714–4.004 (3.063± 0.292). Oral sucker is terminal, it measures 0.210–0.252 (0,234± 0.116)×0,192–0.252 (0.222± 0.014). Preoral spice is developed seldom. It is 0.012–0.018 (0.015± 0.003) long. Relatively small pharynx of globular or oval shape which touches the oral sucker with its front edge is 0.072–0.084 (0.074 ± 0.004) long and 0.060–0.072 (0.066± 0.04) wide. Oesophagus is 0.090–0132 (0.117± 0.021) long. It is split into two intestine branches which end in the half of the distance between vitellaria and end of body. Suckers are very close one to the other, acetabulum is situated in the first fifth of the lenght of the body. It is of lenntil, more rerely of widely oval shape. It mesaures 0.210–0.312 (0.267± 0.025)×0.270–0.360 (0.324± 0.020). It is always larger than the oral suckerrelation 1.15–1.43 (1.300± 0.068). Acetabulum is equally broad as the body of the trematode, auricolas often outreach the end of the body.

Front testis does not rearch into the region of the acetabulum it always is separated from it by several loops of uterus. The loops of the uterus separate also testis and ovary one from another. Testis are situated alnting one behind the other (Fig. 3–4), in several individuals only found position in one line one behind the other (Fig. 5). They are full-edged, of globular or broadly oval shape. Exceptionally individual found having long oval testis (Fig. 6). Another shape of testis found in old trematodes, in which reduction of vitellaria appeared. Their length was tremendously smaller, while width stayed unaffected (Fig.7). Front testis measures 0.198–0.288 (0.242± 0.020)×0.198–0.288 (0.238± 0.021). Rear testis measues 0.216–0.300 (0.242± 0.020)×0.198–0.270 (0.260± 0.031). Vasa eferentia come out from testis which unite in the region of the acetabulum into the only vas deferens in the region joining bursa cirri. Bursa cirri has oval form, broadened on the distal end. It always reaches the region of acetabulum. It measures 0.216–0.300 (0.260± 0.031)×0.102–0.132 (0.118 ± 0.007). It contains several times twisted vesicula seminalis passing into ductus ejaculatorius in the form of a small cirrus, which is seldom exposed out of it. The cirrus is smooth. It measures 0.090–0.150 (0.117± 0.023)×0.042–0.072 (0.056± 0.012). Male genital opening is situated in the region of bifurcation of intestine.



Figs 3–6. ***Brachylecithum strigis*** (Yamaguti) (*Otus scops*, Vitonice, 3-6-1999) variability of body.

Ovary lies behind the rear testis separated from it with several loops of uterus. It is broadly oval, significantly smaller than testes. Just in small number of trematodes are ovary and testes equally large. Ovary is usually situated latellary from the axis of the body. It mesaures 0.132–0.180 (0.155± 0.012)×0.144–0.198 (0.179± 0.013). Behind it significantly smaller receptaculum seminis is situated,which is of globular shape. It mesures 0.090–0.150 (0.108± 0.018)×0.090–0.180 (0.127± 0.027). It is situated in the lateral edge of the body.

Vitellaria are situated behind ovary or evenbehind receptaculum seminis. They are compsed of globular or oval shaped follicles which ara situated laterally. Their branches are not equally long, each takes 1/4–1/3 of the width of the body. The shorter branch is 0.252–0.540 (0.362± 0.066) long,the longer 0.312–0.600 (0.362± 0.066). In the front part, both branches usually unite. In young trematodes they have globular or widely oval form and touch one another. In old trematodes, they degenerate and get smaller. Also their colour changes with the age from cream white or yellow into bronze black. Such coloured follicles will not stained with Borax-Carmin.

Uterus is very wel developed. Filled with eggs it takes all the rear part of the body behind vitellaria. First, it runs zigzag among vitellaria up to the end of the body. Here, it turns, wraps up gonads and forms distinctive cluster in the region of acetabulum. It joins the female genital opening situated above join of bursa cirri. Eggs have well developed shells with lids. Miracidium develops during their maturation. The eggs in uterus move and change their colour from bright yellow up to bronze blac. They measure 0.046–0.051 (0.049± 0.001)×0.029–0.032 (0.032± 0.0001).

***Brachylaime fuscatus* (Rudolphi, 1819)**

(Fig. 7)

Host. *Asio otus*.
Localization. Large intestine.
Intensity of invasion. 1 spec.
Abundance. 1 spec.
Prevalence. 1.4 %.
Locality. January 23, 1977 Hodonín, 7169.
Geographic distribution. Holarctic.

Specific parasite of birds of orders Passeriformes, more rarely found in Columbiformes, Galliformes a Lariformes (Yamaguti 1971). Found in France (Dollfus 1934), U K (Baylis 1928), Italy (Molin 1858), Belgium (Bernard 1987), Germany (Odening 1978), Norway (Bakke 1972), Poland (Machalska 1970),

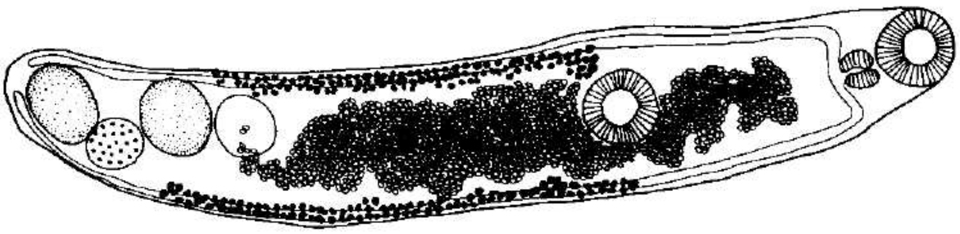


Fig. 7. *Brachylaime fuscatus* (Rudolphi) (*Asio otus*, Hodonín, 23-1-1977).

Slovakia (Macko 1957), Bulgaria (Paspalev & Zhelaskova-Paspaleva 1965), Hungary (Edelényi 1974), Russia (Bykhovskaya-Pavlovskaya 1962), Marocco (Dollfus 1954), Alaska (Babero 1953). In the Czech Republic found by Willomitzer (1953) and Páv (1973). In the United Kingdom found in *Strix aluco* by Ewald & Cropton (1993). *Asio otus* is a new host for this species.

DESCRIPTION (Fig. 7). Trematode of oblong oval shape, 5.331 long. Praecetabular part measures 1.717, acetabular one 0.457 and postabular one 3.289. Distance between ventrall sucker and ovarium makes 2.0. The body reaches its largest width in the region of the ventral sucker, which is 1.114. Oral sucker is of circular shape, terminal, measuring 0.408×0.450. Oval pharynx is situated next behind the mouth sucker and measures 0.198×0.258. Oesophagus is not developed, intestine is split behind pharynx. Its branches run a little slant towards the edge of the body first and along the edge behind testicles. Vitellaria begin in about a half of the ventral sucker and reach the middle of the front testes. The left branch is 2.743 long, the right one 2.860. Round shaped testes are situated at the end of the body, the front one measuring 0.482×0.458, the rear one 0.482×0.482. Ovarium of oval shape is situated between testes measuring 0.462×0.450. Mehlis gland measuring 0.450×0.450 is situated in front of the testes. Uterus is well developed, it begins in the region of the Mehlis gland filling all the space among yolk vitellaria. It terminates in the first third of the distance between the suckers. Eggs measure 0.029–0.032×0.016.

Leucochloridium perturbatum **Pojmanska, 1969**

(Fig. 8)

HOST. *Asio otus*.
LOCALIZATION. Large intestine.
INTENSITY OF INVASION. 1 spec.
ABUNDANCE. 1.0 spec.
PREVALENCE. 1.0 %.
LOCALITY. January 23, 1977 Hodonín, 7168.
GEOGRAPHIC DISTRIBUTION. Holarctic.

A very spread trematode parasiting in birds of orders Passeriformes and Charadriiformes mentioned under the name *L. actitis*, Price 1930 (Yamaguti, 1971). Occurrence in the Czech Republic summarized Sitko (1993). *Asio otus* is a new host for this species.

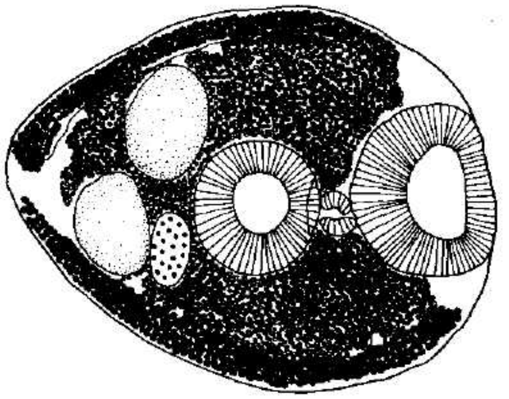


Fig. 8. *Leucochloridium perturbatum* Pojmanska (*Asio otus*, Hodonín, 23-1-1977).

DESCRIPTION (Fig. 8). Trematode of pear shape with very strongly developed suckers. The body is 1.914 long and 1.486 wide. Praeacetbular length 0.714, acetabular one 0.506, postacetabular one 0.686. Oral sucker is terminal, broadly oval, measuring 0.506×0.590. Ventral sucker is round shaped measuring 0.506×0.566. Round shaped pharynx is situated between suckers measuring 0.180×0.180. Oesophagus is not developed, intestine is split next behind the pharynx, intestine branches run slant upwards as far as the middle of the mouth sucker and then along the lateral edge of the body behind testes. Vitellaria are strongly developed. They begin on the level of the middle of the mouth sucker and terminate behind testicles covering intestine branches. The left branch is 1.543 long, the right one 1.657. Genital organs are of oval shape. They are arranged into a triangle. The front testes measures 0.300×0.420, the rear one 0.330×0.420. Ovarium measures 0.120×0.300. Uterus is very strongly developed and covers all the organs with its loops. Eggs measure 0.021–0.024 (0.023)×0.014–0.016 (0.015).

Strigea falconis Szidat, 1928
(Fig. 9)

HOST. *Asio otus*.
LOCALIZATION. Intestine.
INTENSITY OF INVASION. 20 spec.
ABUNDANCE. 20.0 spec.
PREVALENCE. 1.4 %.
LOCALITY. June 30, 1964 Napajedla, 6871.
GEOGRAPHIC DISTRIBUTION. Cosmopolitan.

Specific trematode of birds of prey, spread all over the world (Dubois 1968). Exceptionally found in birds of the orders of Charadriiformes, Galliformes, Columbiformes and Passeriformes. Findings in owls are rare, found in *Asio flammea*, *Asio otus* and *Strix aluco* (Skryabin 1959). Possible confusion of the species *Strigea strigis* in older authors. Found in birds of prey in the Czech Republic by Tenora & Lusk (1960), Škarda (1964) and Sitko (1998).

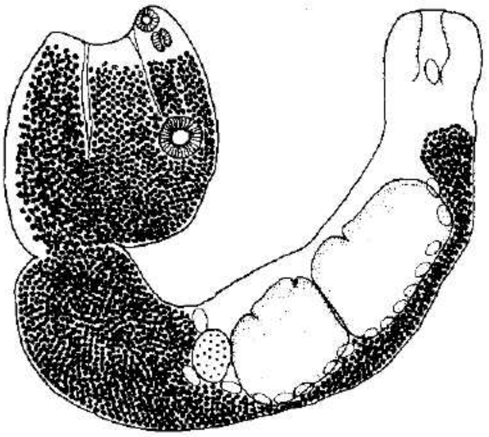


Fig. 9. *Strigea falconis* Szidat (*Asio otus*, Napajedla, 30-6-1964).

Description (Fig. 9; 10 specimens measured). Overall length of the body 2.857–4.146 (3.568). Forebody in the shape of a deep cup or ball with larger or smaller opening, which, in strongly shrunk specimens, can be fully closed. Out of the opening, lobules of tribocytic organ protrude. Forebody is 0.686–1.143 (0.936) long, 0.723–1.029 (0.930) wide. Hindebody is cylindrical, slightly narrow towards both ends, arch shaped. It is always a little bit narrower and 1.62–2.57 (2.11) times larger than the front segment. The border between segments is situated on the protruding dorsal edge of the front segment. It is very well obvious, broadly oval, 0.132–0.180 long, 0.120–0.144 (0.1215) wide. Pharynx is broadly oval, situated in the tight vicinity of the oral sucker, sometimes reaching into its region. It measures 0.096–0.144 (0.119)×0.108–0.144 (0.124). Ventralal sucker is 1.118–2.25 (1.54) times larger than the mouth sucker. It measures 0.180–0.241 (0.209)×0.180–0.216 (0.197). Ovarium is oblong oval, situated in 1/5–2/5 of the hindebody. It touches the front testes with its rear edge and is 0.180–0.241 (0.202) long, 0.241–0.361 (0.285) wide. Broadly lobate testes take all the rear half of the segment. The front one is always a little smaller than the rear one. The front testes measures 0.361–0.663 (0.460)×0.361–0.602 (0.530), the rear one 0.361–0.602 (0.530)×0.422–0.699 (0.510). Vitellaria in the front segment reach the rear edge of the pharynx. Laterally they are strongly developed, development in the medial line in the region of the ventral sucker is much less. In the hidebody, they are concentrated especially in the region in front of ovarium and laterally behind testes. They terminate behind testes in the region of begin of the genital atrium, but do not penetrate it. The genital atrium is 0.120–0.270 long. There is a plenty of eggs, measuring 0.103–0.108 (0.106)×0.070–0.076 (0.071).

Strigea strigis **(Schrank, 1788)**

(Fig. 10)

Hosts. *Asio otus*, *Strix aluco*, *Bubo bubo*.
Intensity of invasion. *Asio otus* 1–147 spec., *Strix aluco* 1–173 spec., *Bubo bubo* 1 spec.
Abundance. *Asio otus* 33.4 spec., *Strix aluco* 29.0 spec., *Bubo bubo* 1.0 spec.
Prevalence. *Asio otus* 22.5%, *Strix aluco* 29.2%, *Bubo bubo* 5.0%.
Localities. September 27, 1996 Bartošovice, 6374, March 11, 1993 Čermotín, 6472, April 30, 1964 Napajedla, 6871, July 26, 1982 Lipník nad Bečvou, 6471, March 15, 1976 Hodonín, 7168, Otober 27, 1992 Potštát, 6371, January 5, 1994 Prusy, 6570, March 4, 1991 Přerov, 6570, January 25, 1977 Ratiškovice, 7069, February 21, 1963 Rosice, 6864, April 26, 1967 Strachotín, 7165, Januaary 21, 1982 Štěpánov, 6369, March 11, 1993 Valašské Meziříčí, 6474.
Geographic distribution. Palaearctic.

A specific trematode in owls, frequently found in all the examined species in various countries of Europe and Asia. It is not possible to verify older data on occurrence, they were not confirmed by later researches. Authors described species *S. falconis* as *S. strigis* (Dubois 1968). In the Czech Republic found Ryšavý (1957) and Tenora & Lusk (1960).

Description (Fig. 10; 10 specimens found in *Asio otus* March 4, 1991 Přerov, mesaured and depicted). The overall length of the body 3.730–7.146 (4.521). Forebody in the shape of a deep cup or ball with a larger or smaller opening, which can be closed in strongly shrunk specimens. Lobules of the tribocytic orgal usually mostly do not significantly protrude out of the front segment, which measures 1.126–2.0 (1.221)×1.0–1.286 (1.112). Hidebody is cylindrical or bent into an oval arch. It is 2.40–5.146 (3.142) long. It reaches its largest width of 0.857–1.314 (1.089) at the level of testicles. The rear segment is 1.91–2.67 times longer than the front one. Division of segments is well obvious. Oval sucker is round or oval shaped. It is situated on the ventral edge of the front segment, from which it protrudes. It measures 0.132–0.161 (0.146)×0.114–0.210 (0.152). Ventral sucker is situated in the inner part of the front segment. It is round or oval shaped and measures 0.210–0.270 (0.247)×0.210–0.30 (0.243). It is 1.44–2.1 times larger than the mouth sucker. Pharynx is situated tightly behind the mouth sucker or in its region. It is 0.090–0.138 (0.112) long and 0.090–0.150 (0.106) wide. Ovarium is situated in the first quarter of the hindebody, it is oval, broadly lobate, and measures 0.180–0.422 (0.280)×0.253–0.566 (0.432). Testes are situated one behind another in the middle of the hindebody. They are oval, deeply lobate. The front one is always a little smaller than the rear one. The front testicle is 0.240–0.783 (0.547) long, 0.723–1.060 (0.854) wide. The rear testicle measures 0.270–0.843 (0.664)×0.783–1.108 (0.894). Vitellaria are strongly developed. They reach as far as the edge of the ventral sucker in the front segment and homogeneously fill in the whole segment. In the hidebody, they are situated mainly in the region in front of ovarium and laterally behind testicles. In the hindebodyt, they reach genital come and terminate as far as its end. The genital cone is well developed and is 0.270–1.060 (0.850) long. Genital openinng is terminal. Plenty of eggs developed are developed which measure 0.113–0.124 (0.120)×0.079–0.094 (0.086).

Neodiplostomum canaliculatum **(Nicoll, 1914)**

(Fig. 11)

Host. *Strix aluco*.
Localization. Small intestine.
Intensity of invasion. 1–10 spec.
Abundance. 4.7 spec.
Prevalence. 12.5 %.
Locality. May 15, 1995 Přerov, 6570.
Geographic distribution. Palaearctic and Oriental regions.

Characteristic trematode in owls, found in *Bubo bubo*, *Asio flammea*, *A. otus*, *Strix uralensis*. Found in Egypt and Sudan (Dubois 1970), Russia (Bykhovskaya-Pavlovskaya 1962), Ukraine (Odening & Bockhardt 1961). In the Czech Republic found for the first time. *Strix aluco* is a new host of this species. Young trematodes found, sizes of suckers are on the lower edge of the reported data. Front segment is slightly macerated, what caused extension of the region between suckers and due to that changes of the shape of the body.

Description (Fig. 11; measured 6 specimens). Overall length of the body 1.714–2.229 (2.089). Forebody tongue shaped, 0.857–1.714 (1.309) long, 0.429–0.60 (0.503) wide. Hindebody cylindrical,

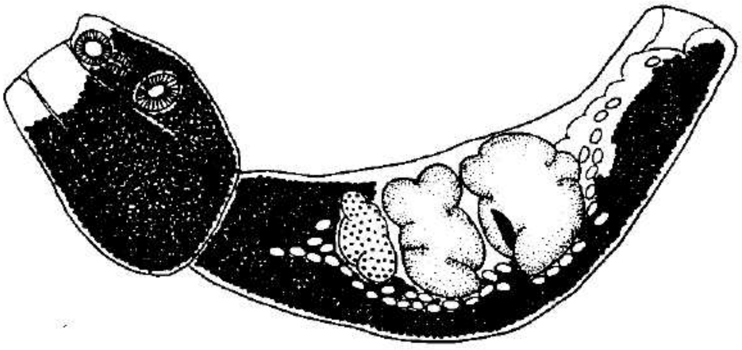


Fig. 10. *Strigea strigis* (Schrank) (*Asio otus*, Přerov, 4-3-1991).

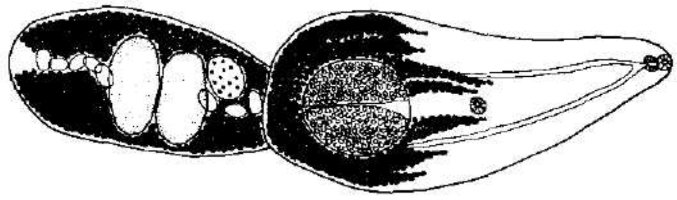


Fig. 11. *Neodiplostomum canaliculatum* (Nicoll) (*Strix aluco*, Přerov, 15-5-1995).

0.857–1.114 (0.933) long, 0.343–0.571 (0.434) wide. There is an obvious boarder between segments. The segments are equally long or the front segment is 1.03–1.66 (1.36) times longer. Oral sucker is terminal, round or oval shaped, measuring 0.046–0.059 (0.054)×0.054–0.059 (0.056). Oval shaped pharynx situated next to the ventral sucker measures 0.046–0.059 (0.053)×0.036–0.046 (0.044). Oral sucker is 1.12–132 (1.13) larger than the pharynx. Ventral sucker of oval or round is always larger than the oral one and is 0.062–0.076 (0.068) long, 0.057–0.070 (0.065) wide. Tribocytic organ is situated in the lower half of the forebody. It is oval shaped measuring 0.114–0.360 (0.275)×0.108–0.270 (0.203). Ovarium is round or broadly oval shaped measuring 0.120–0.180 (0.148)×0.150–0.222 (0.185). It is situated in the region where segments are separating one from another. Testes are broadly oval, situated one behind another. The front testicle is regularly smaller than the rear one. The front one measures 0.150–0.210 (0.190)×0.270–0.330 (0.299), the rear one 0.150–0.210 (0.185)×0.282–0.336 (0.318). Vitellaria are strongly developed. In the front segment, they reach in front of the ventral sucker, their largest part is in the region of the tibocytic organ. In hindebody, they are most in the ovarium region. They cover testes in two broad stripes and terminate at the end of the body. Genital atrium is broad with a large opening. Uterus contains a small number of eggs, which measure 0.097–0.103 (0.102)×0.065.

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Lestodiplosis xylodiplosuga sp. n., a predator of *Xylodiplosis* sp. (Diptera: Cecidomyiidae): morphology of developmental stages, biology and behaviour

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Abstract. Adults and developmental stages of *Lestodiplosis xylodiplosuga* sp. n. are described and its diagnostic characters are illustrated. Predaceous larvae attack and suck out larvae of *Xylodiplosis* sp. which develop in young xylem vessels of freshly cut trees. Larvae of *Lestodiplosis xylodiplosuga* sp. n. were found on cut surfaces of *Quercus robur*, *Q. petraea*, *Q. rubra* and *Fraxinus excelsior*. Adults fly from May to October. They have circadian activity. Females lay eggs on cut surfaces of trees. Larvae search for prey inside the vessels on cut surfaces and attack larvae creeping from openings of xylem vessels. Larvae spend the most time hidden in the xylem vessels. Their development lasts about one month. Full grown larvae spin cocoons on plant surfaces and dead material. Pupation lasts 2-4 weeks. Development of one generation lasts 1.5–2 months. At least two generations develop in one year. In winter larvae search for prey even at temperatures of +2°C and survived temperatures down to –14°C. Shortly after emergence females suck water. Sucking process lasted 1,5 and 5,5 minutes and was repeated later. Females after sucking display specific sexual behaviour. They stretched out the two last abdominal segments, slowly moved them and probably released sexual pheromone to attract males. Virgin females lived 3 to 6,5 days under laboratory conditions. Hungry larva of *Lestodiplosis xylodiplosuga* sp. n. attacks *Xylodiplosis* larva, sticks mouthparts into the body of the prey and injects a secretion of salivary glands including inhibiting and paralysing substances together with digestive enzymes. Attacked *Xylodiplosis*-larvae stop movement and become calm. Salivary gland secretions cause firstly immobility and subsequently general paralysis. Larvae of *Lestodiplosis xylodiplosuga* sp. n. suck out partially digested solutions of the prey, with the exception of the larval fat body (*corpus adiposum*), within five hours (extraintestinal digestion). Usually only one larva of *Lestodiplosis xylodiplosuga* sp. n.attacks one *Xylodiplosis*-larva, but up to three larvae of *Lestodiplosis xylodiplosuga* sp.n. were found sucking one larva of *Xylodiplosis* Kieffer, 1894.

Taxonomy, new species, morphology of developmental stages, biology, behaviour, predator-prey relationships, Diptera, Cecidomyiidae, Palaeartic region

INTRODUCTION

In 1995, during field studies on the biology and ecology of xylophilous gall midges associated with forest trees in southern Germany, predaceous larvae of a cecidomyiid feeding on larvae of *Xylodiplosis* spp. were discovered. Larvae and reared adults of this predaceous gall midge belong to the genus *Lestodiplosis* Kieffer, 1894 (Diptera: Cecidomyiidae) and to a new species.

Predaceous gall midges, often called also zoophagous, usually are not so abundant and are less well known than phytophagous gall midges, the majority of which induce galls on various plants. In the Palaearctic Region more than 2200 gall midge species have been described. Only about 130 species of these belonging to several genera are predators. Their larvae feed on other gall midges, aphids, mites, coccids and various other small invertebrates (Skuhravá et al. 1984). Previously known information about the zoophagous gall midges has been summarized by Nijveldt (1969).

Lestodiplosis Kieffer, 1894 is a large, cosmopolitan genus with more than 150 species described in the world. Most of them, about 90, occur in the Palaearctic Region (Skuhravá 1986), about 50 species in North America (Gagné 1973) and the rest in other regions. Larvae of many species feed on other gall midges (Diptera: Cecidomyiidae), on gall wasps (Hymenoptera: Cynipidae), some on mites (Acari: Eriophyoidea), psyllids (Sternorhyncha: Psylloidea), coccids (Sternorhyncha: Coccinea), beetles (Coleoptera: Scolytidae), diplopods (Diplopoda), two species are associated with cones of coniferous trees, and the host of several species is unknown. A catalogue of Palaearctic species with brief biological data is given in Skuhravá (1986). Most species are poorly known, inadequately described and also data about their biology and behaviour are insufficient. In the past, the *Lestodiplosis* species were described on the assumption that each species is prey-specific, i.e. that the larva of the particular *Lestodiplosis*-species attacks only one particular species of prey. That was the reason which led Barnes (1927, 1928, 1929, 1934) to the description of 30 new species of the genus *Lestodiplosis*. Later Barnes (1953), on the basis of his own biological observations, concluded that some *Lestodiplosis*-species probably are not monophagous. Parnell (1963) observed *Lestodiplosis* larvae feeding on various hymenopterous larvae and pupae in pods of *Sarothamnus scoparius* which supported the supposition that the larvae are polyphagous. Also Harris (1982) mentioned in his description of a new acariphagous gall midge, *Lestodiplosis oomeni* Harris, 1982, that larvae feed on eggs, juvenile and adult stages of *Calacarus carinatus* (Green), *Acaphylla theae* (Watt) (Acari: Eriophyoidea), *Brevipalpus phoenicis* (Geijskes) (Acari: Tenuipalpidae) and also incidentally on unidentified Psocoptera, all occurring on tea plants (*Camellia sinensis*). Based on these results, Gagné & Bennett (1993) concluded that some *Lestodiplosis*-species may be specialist and some generalist predators. Among about ninety *Lestodiplosis* species described in the Palaearctic region so far, no larvae were found to prey on larvae of the genus *Xylodiplosis* Kieffer, 1894.

Little is known about the predator-prey relationships, behaviour and processes of predation of *Lestodiplosis*-larvae. Otter (1934) studied the larval head capsule of *Lestodiplosis alvei* Barnes, 1934 and the organs used in the process of sucking out the prey. This process has been studied in detail on aphid-eating larvae *Aphidoletes aphidimyza* (Rondani, 1847). The function of the salivary glands in the action of the predatory larvae was investigated by Mayr (1975) and the mechanism of predation has been elucidated by Solinas (1968). Biology, ecology and nuptial parade were studied in detail by Baylac (1986a) on *Lestodiplosis* sp., larvae of which prey on a coccid *Cryptococcus fagi* (Coccinea). Baylac (1987) also contributed to knowledge of *Lestodiplosis* by his analy-sis of morphological characters of larval head capsule of several species and by his notes about the polymorphism of the shape of spots on the wings (Baylac 1986b).

MATERIAL AND METHODS

All observations about the biology and behaviour of larvae and adults of *Lestodiplosis xylodiplosuga* sp. n. and all experiments were done in an oak forest at Rottenburg am Neckar in southern Germany from 1995 to 1999. The occurrence of *Lestodiplosis xylodiplosuga* sp. n. is closely conditioned by the occurrence of its prey, the *Xylodiplosis*-larvae. Females of *Xylodiplosis* search for recently cut wood of deciduous trees and lay their eggs inside xylem vessels where larvae subsequently develop. Mature larvae leave the vessels and fall to the soil where they pupate. Larvae of *L. xylodiplosuga* sp. n. were observed to search for larvae of *Xylodiplosis* inside the xylem vessels or to attack larvae of *Xylodiplosis* when they leave xylem vessels of oak wood.

The life cycle of *Lestodiplosis xylodiplosuga* sp. n., occurrence of adults and larvae in nature and relationships between *Lestodiplosis xylodiplosuga* sp. n. and its prey, larvae of *Xylodiplosis*, were observed in one forest stand. Behaviour, life span of individuals and predator-prey relationships between larvae of *Lestodiplosis xylodiplosuga* sp. n. and larvae of *Xylodiplosis*, behaviour of virgin females calling males and behaviour of larvae of *Lestodiplosis xylodiplosuga* sp. n. searching for prey were observed under laboratory conditions. Several small experiments to elucidate the behaviour of larvae of *Lestodiplosis xylodiplosuga* sp. n. in relation to their prey were arranged in the laboratory. Adults either after emergence, or after death, and immature stages were deposited in 75% alcohol. For morphological studies the specimens were mounted on microscope slides using Canada Balsam or Liquido Faure as medium.

The junior author is responsible for field observations and laboratory experiments, the senior author for determination and description of the new gall midge species.

RESULTS

Lestodiplosis xylodiplosuga sp. n.

TYPE MATERIAL. Holotype: male, Germany, Rottenburg am Neckar, emergence 28.x.1995, leg. K. Dengler, slide Nr. 7197, from larva preying on larva of *Xylodiplosis* sp. Paratypes: 2 males and 2 females, same locality, emergence 4.–8.ix.1997; 1 larva, same locality, 15.ix.1996; 10 larvae, same locality, 1997: all in collection of M. Skuhravá in the National Museum in Prague.

Adult (Figs 1–7)

DESCRIPTION. Body size of male: 1.5 mm (1.2–1.6 mm; n = 6), of female 1.9 (1.5–2.27 mm; n = 10). Body colour: Adults in fresh condition have head, thorax and legs blackish, abdomen orange coloured. Legs and wings of freshly emerged adults are densely covered with long black setae which fall off in the course of the individual life and during subsequent preparation of microscope slides.

Head with occiput rounded, occipital process present. Head with large holoptic eyes. Eye bridge 7–8 facets broad. Eyes with relatively large, circular ommatidia, not closely adjacent. Frontoclypeus prominent, with a group of long setae.

Mouthparts well developed, forming a lapping organ. Labrum and labella densely covered with short setae. Maxillary palps four segmented; first segment very short, the fourth segment the longest. All segments densely covered with microtrichia and with several setae.

Antennae in both sexes 2 + 12 segmented. Scapus subconical, pedicellus globular, first and second flagellomeres fused. Each male flagellomere with two unequal nodes and two narrow stems. The proximal node is rounded, with one whorl of circumfilar loops, the distal node is prolonged, with two whorls of circumfilar loops. Nodes are equiped with several long sensorial setae and sparsely covered with microtrichia. Female flagellomeres are slender, each with long stems and with basal nodes sparsely covered with microtrichia and with several setae and two whorls of loose looped sensorial threads.

Wing 2 mm long and 0.95 mm broad and without any pattern of scales. Costa interrupted at the point of junction with R_5. R_1 reaches to the middle of the anterior margin of the wing. R_5 almost straight joining costa at the wing apex. Cu forked.

Legs long, very slender, densely covered with hairs. Tarsal claws simple on all legs, 30–35 µm long; claws bent near midlength, empodia as long as claws.

Male abdomen. 1st to 6th tergites with posterior row of small setae. Genitalia with gonocoxites slender, 170 µm long and 40 µm broad, with many setal insertions. Gonocoxites with mediobasal, triangular lobe; lobe densely covered with hairs. Gonostyles slender, curved, 100 µm long and 12 µm broad, at the end forked forming a small pincers; microtrichia only at the base. Cerci (upper lamella, superior lamella, X. tergite): deeply and narrowly excised. Hypoproct (lower lamella, inferior lamella, X. sternite): narrow, rounded apically, with two long setae. Aedeagus slender, rounded apically, with several small pores at the end. Cerci and hypoproct densely covered with microtrichia. Cerci as long as hypoproct, reaching about the middle of gonocoxites; aedeagus much longer than cerci and hypoproct.

Female abdomen. 1st to 7th tergites with posterior row of small setae and sparsely covered with setae, 8th abdominal segment with long setae. Ovipositor short, slightly telescopically protractile and retractile (based on observations in the course of sexual behaviour when the female is calling males). At the end of the ovipositor a pair of cerci (superior lamellae), 90–100 µm long, in lateral view pointed, in dorsal view rounded, and one unpaired triangular inferior lamella, 30 µm long. Cerci densely covered with short hairs, apically covered with short, stronger setae.

DIFFERENTIAL DIAGNOSIS AND COMMENTS. 89 nominal species of *Lestodiplosis* are listed in the Catalogue of Palaearctic Diptera (Skuhravá 1986). When first described, mainly by Rübsaamen, Kieffer or Barnes, most of these were assumed to be host-specific (which seems highly unlikely but still unproven). Most species have been recorded once only, on occasion of their first description, and in almost every case the original descriptions are inadequate, the type material is lost or not available for study or, if so, is of extremely poor quality. In these circumstances it is impossible to recognise again species described in earlier literature. It is therefore possible that the species described here has been previously described but, until a major revision of the genus can be underta-ken, it seems best to publish a formal description with details of its biology. *Lestodiplosis xylodiplosuga* sp. n. belongs in the *Lestodiplosis urticae* group of species, as recognised by Baylac (1987) and may be conspecific with his *Lestodiplosis* sp. B.

Several differences were found which may help to recognise the new species. The male of *Lestodiplosis xylodiplosuga* sp.n. differs from the male of *L. pictipennis* (Perris, 1870), the type-species of the genus *Lestodiplosis*, in the shape of male terminalia. That is the unique organ which have been figured in the past by Kieffer (1900, pl. 19: fig. 11., redrawn by Skuhravá, 1997, fig. 633). Cerci of *Lestodiplosis xylodiplosuga* sp. n. are narrowly and deeply excised, in contrast to cerci of *L. pictipennis* which are broadly and shallowly emarginate; aedeagus of *Lestodiplosis xylodiplosuga* sp. n.is relatively broad, rounded apically, with several pores and it is shorter than gonocoxites, in contrast to the aedeagus of *L. pictipennis*, which is narrow, apically broadened into a bump, without pores, extending beyond the gonocoxites.

Lestodiplosis xylodiplosuga sp. n. is noted for several unique characters which do not occur in any known *Lestodiplosis* species: in male the gonostyli with small pincers apically; in female flagellomeres two whorls of loose loops of sensorial thread; larva with two large tubercles on terminal segment of abdomen. *Lestodiplosis xylodiplosuga* sp. n. is distinguishable from *L. trifaria* Yukawa et Sanui, 1978, by the following combination of characters: number of palpal segments; four palpal segments in *Lestodiplosis xylodiplosuga* sp. n. and three in *L. trifaria*; male terminalia of *Lestodiplosis xylodiplosuga* sp. n. with triangular cerci narrowly excised, in contrast to linear cerci, broadly excised cerci of *L. trifaria*; aedeagus of *Lestodiplosis xylodiplosuga* sp. n. relatively broad, in contrast to very narrow aedeagus of *L. trifaria*.

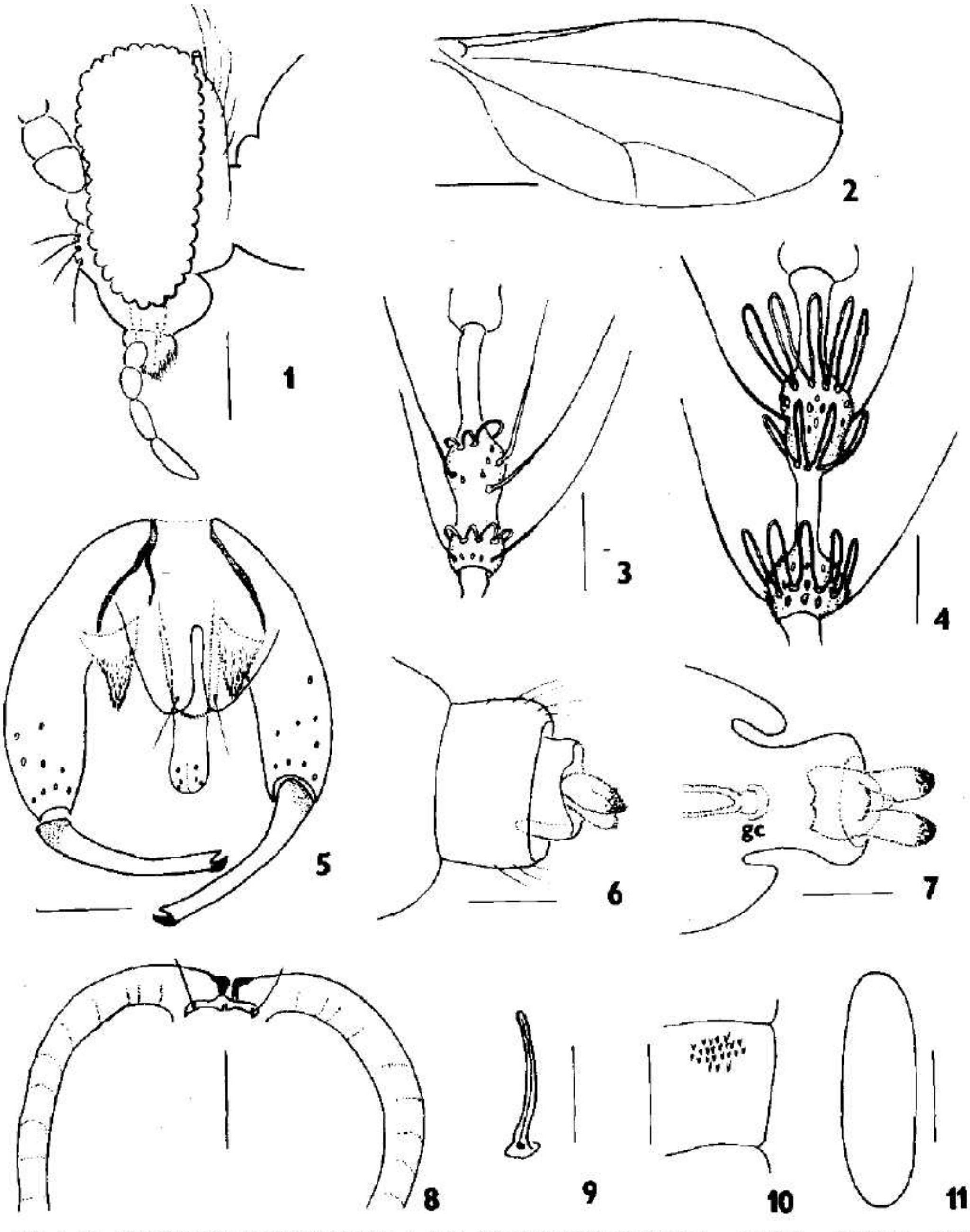
NAME DERIVATION. The specific name *xylodiplosuga* is a compound noun, the first part of which refers to the generic name of the prey, *Xylodiplosis*, and the second part to the fact that *Lestodiplosis* larvae suck their prey. It is derived from the Latin verb *sugere*.

Larva (Figs 12–17)

The larval development of *Lestodiplosis xylodiplosuga* sp. n. includes three larval instars. The first instar larva has not been detected in the course of our experiments. Females probably lay their eggs in the proximity of the prey, the *Xylodiplosis* larvae, near the openings of xylem vessels and newly hatched larvae of *Lestodiplosis xylodiplosuga* sp. n.search for their prey inside the xylem vessels.

The body of the second instar larvae is 1.26–1.27 mm long and 0.24–0.3 mm broad. The head capsule, measured from its most anterior part to the end of postoccipital apodeme, is 35–60 µm long and 30–45 µm broad. The antenna is 20–44 µm long. Terminal setae of the anal segment are 75–90 µm long.

The body of the third instar larvae is 1.8–2.2 mm long and 0.2–0.48 mm broad. The body is fusiform, markedly narrowed anteriorly, orange coloured, head distinct, strongly sclerotized and, therefore black coloured, with relatively long, forwards directed antennae. Inside the prothoracic



Figs 1–11. *Lestodiplosis xylodiplosuga* sp. n. 1–3, 6,7: female; 4–5: male; 1 – head; 2 – wing; 3 – third flagellomere; 4 – third flagellomere; 5 – hypopygium; 6 – ovipositor (lateral view); 7 – ovipositor (dorsal view); gc – genital chamber; 8 –10: pupa; 8 – basal part of antennal sheaths; 9 – prothoracic horn; 10 – structure on 3rd abdominal segment; 11 – egg. Scale line: 50 µm: 3, 4, 5; 100 µm: 1, 6, 7, 11; 200 µm: 8, 9, 10; 500 µm: 2.

segment is a visible black spot – the larval eye organ. The body is covered with long setae dorsally and with prolegs (*pedes spurii* after Möhn, 1955; pseudopods after Gagné 1993). *Spatula sternalis* absent. Respiratory system peripneustic, with a pair of spiracles on prothorax and on 1st to 8th abdominal segments.

The head capsule is 95–135 µm long, 40–65 µm broad; antennae are uniarticulate (see Solinas et al. 1987), 50 µm long and 5–6 µm broad at its base. Inside the head capsule is the cephalopharyngeal skeleton the apodemes of which reach inside the prothorax. The mandibles are pointed. The simple eye organ in the form of a small black spot is situated deeply inside the prothorax near the end of the cephalopharyngeal apodemes. It is formed by a cluster of small pigmented granules and provides directional perception of light.

The integument of the dorsal and ventral sides of thoracic and abdominal segments is smooth, without any cuticular patterns. Each segment of dorsal side with 6 dorsal papillae bearing long setae; four setae are 80um long, two setae (2nd and 5th of each row) with 40 µm long setae. Two dorsal papillae and two lateral papillae of the 8th abdominal segment with setae 130 µm long. Terminal segment with 6 terminal papillae, each with 100 µm long seta. Anus small, situated dorsally.

Ventral side of prothorax with three pairs of papillae; one pair with a seta 65–70 µm long, one pair with 10 µm long seta and one pair without seta. Ventral side of mesothorax and metathorax medially with two prolegs, 1st–7th abdominal segments medially with three prolegs. Prolegs are cone-shaped fleshy tubercles, about 45–50 µm long, with the end a little broadened, with finger-shaped structures and several small locomotory spicules apically (seen only on electron-microscope scans). Prolegs are transformed ventral papillae, occurring on the ventral side of other gall midge larvae, and are used for locomotion. 8th abdominal segment is reduced in size, without prolegs. Terminal segment with six terminal papillae on the dorsal side and with two large tubercles on ventral side which are directed downwards and are used, similarly as prolegs, in locomotion and serve for attachment to the base by creeping and as prop while searching prey in xylem vessels.

Prepupa

Prepupa is a quiescent stage preceding the pupal stage. This stage has been discovered in one larva of *Lestodiplosis xylodiplosuga* sp. n., 23.5 days old, after 23 days of starvation in 1997. The body of this stage is 1.6 mm long, 0.55 mm broad. It is shortened in comparison with the body of normal, living and moving larvae. Head part is retracted within the thoracic segments. All setae and other appendages covering the larval body are clearly visible. Under the skin of the larva it is possible to see the body of the differentiating pupa. Inside the pupal body many small concretions of the diameter of 15–20 µm are visible. Concretions are formed by the union of many separate particles. These are probably excreta which remain inside the pupal body. Gall midge larvae do not excrete undigested parts of food from their body in the course of their larval development.

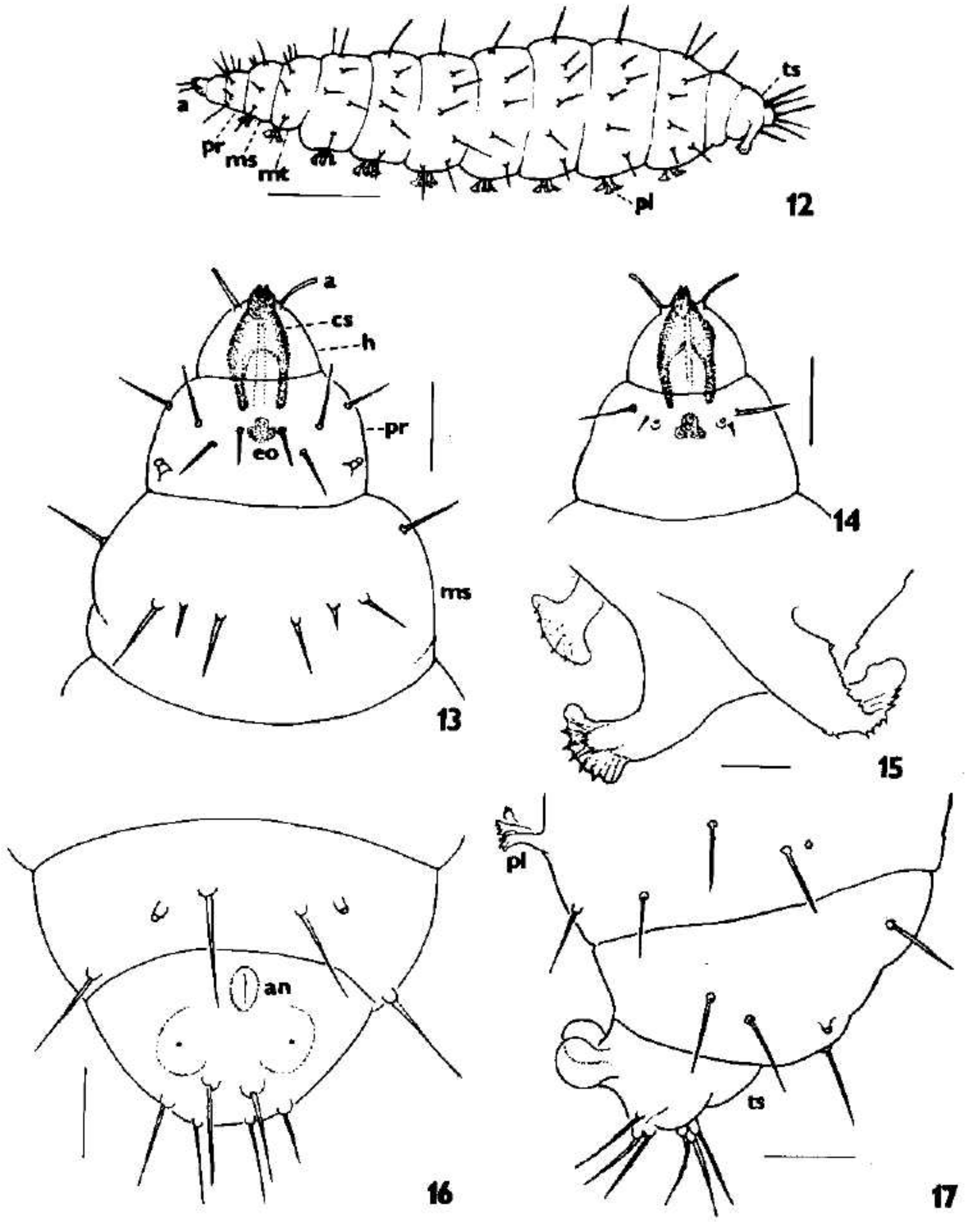
Pupa (Figs 8–10)

The pupa is 2300 µm long and 800 µm broad, orange coloured in fresh condition. Pupal exuvia, cast-off skin of pupa, is hyaline. Basal part of each antennal sheath with a small sclerotized tubercle situated antero-medially.

Cephalic sclerite narrow, with two papillae, each bearing 100 µm long seta. Face without protuberances. Prothoracic spiracle 300 µm long, tapering from base to tip, with trachea reaching its apex. Abdominal segments dorsally with 4–5 transverse rows of small spines.

Egg (Fig. 11)

The egg, fully developed at the moment of egg-lying, is ovoid in shape, 110 mm long, 80 µm broad, in fresh condition whitish. Females immediately after emergence have their abdomen full of eggs, in one abdomen about 50 eggs at various developmental stages were observed.



Figs 12–17. *Lestodiplosis xylodiplosuga* sp. n., larva. 12 – larva total in lateral view; 13 – head, prothorax and mesothorax in dorsal view; 14 – head and prothorax in ventral view; 15 – three prolegs of ventral side of abdominal segment III; 16 – terminal segment, dorsal view; 17 – abdominal segment, lateral view. Figs 12 and 15 redrawn from electron-microscope scan. Abbreviations: a – antenna; an – anus; cs – cephalopharyngeal skeleton; eo – eye organ; h – head; ms – mesothorax; mt – metathorax; pl – prolegs; pr – prothorax; ts – terminal segment. Scale line: 10 µm: 15; 100 µm: 13, 14, 16, 17; 300 µm: 12.

BIOLOGY

Flight of adults

Adults of *Lestodiplosis xylodiplosuga* sp. n. freshly emerging from pupae fly in nature, in oak and mixed forest stands, from the beginning of May up to the end of October. In this habitat they are scarce and occur more abundantly during the summer months. In the course of 24 hours, the adults fly and are active both in the day and also in the night, showing circadian activity. This seems to be an adaptation to the predatory mode of life.

Larvae of *Lestodiplosis xylodiplosuga* sp. n.were found searching for or sucking the larvae of *Xylodiplosis* which developed on *Quercus petraea*, *Quercus robur*, *Quercus rubra* and rarely on *Fraxinus excelsior*. Fresh cut surfaces of tree trunks and branches of these trees were highly attractive for both the females of *Xylodiplosis* and of *Lestodiplosis xylodiplosuga* sp. n.

Behaviour of adults

Females of *Lestodiplosis xylodiplosuga* sp. n. shortly after their emergence in laboratory conditions actively seek water, i.e. dew or other kinds of water or humidity. The process of sucking water by female lasted 1.5–5.5 minutes. One females repeated sucking water three days later. Three unfertilized females, which had sucked water, lived three, six and six and a half days under laboratory conditions.

Several minutes after sucking water, females showed **sexual behaviour** to attract conspecific males for mating. Females push out the end of abdomen slowly, raising the two last segments together with apical lamellae and moving with this part more or less with a jerk from one side to another in the course of about 8 minutes. Then the abdominal end was returned to the initial position. After several minutes the female repeated this action for 25 minutes. This female, artificially disturbed, flew to a new place and there resumed the action. Such behaviour of females of *Lestodiplosis xylodiplosuga* sp. n. was observed not only during the day, but even during the night. The females evidently in the course of such action release a sexual pheromone from the abdominal end to attract males for mating.

One virgin, i.e.unmated and unfertilized female, which lived six and a half days, laid three eggs on the floor of the emergence cage shortly before its death. In nature the females of *Lestodiplosis xylodiplosuga* sp.n. lay eggs on the cut surface of wood, not inside openings of xylem vessels, as do the females of *Xylodiplosis*. This fact is connected with the shape of ovipositor. The females of *Xylodiplosis* have a very long and very slender, thin, protrusible ovipositor, whereas the females of *Lestodiplosis xylodiplosuga* sp.n. have a short, non protrusible ovipositor ending with broad lamellae.

Behaviour of larvae

Larvae of *Lestodiplosis xylodiplosuga* sp. n. spend most of their development hidden inside the xylem vessels. When they are hungry they appear at day- and night-time on the cut surface where they search for prey. There is no sign of sensitivity to light of any kind and intensity. Larvae are active even in the winter months at temperatures of about +2 °C. Within the range of 2–6 °C they move extremely slowly. They survived temperatures down to –14 °C without damage.

Other abiotic factors, such as high temperatures during summer days, high humidity or hot and dry weather do not affect behaviour of larvae of *Lestodiplosis xylodiplosuga* sp. n. in their effort to find their prey. The position and orientation of cut surfaces and the morphological arrangement of the wood (position of xylem vessels) do not influence their behaviour.

Behaviour of larvae of *Lestodiplosis xylodiplosuga* sp. n. that are hungry differs distinctly from those that are fully-fed. Hungry larvae are very unquiet and are continuously moving and searching for prey (**appetence behaviour**). They are looking for *Xylodiplosis*-larvae on the cut surface and penetrate with their anterior body part into openings of xylem vessels. Their anterior body part is in movement nearly all the time, constantly it is turned to the right and to the left, here and there, mainly directed slanted down toward the wood, often into the openings of vessels. Sometimes the larva penetrates a bit deeper into a vessel. Some larvae of *Lestodiplosis xylodiplosuga* sp. n. get even deeper into a vessel and their body is quite hidden inside such vessel. After several seconds *Lestodiplosis* larvae withdraw from the opening of such vessels and continue to search for the prey at other places.

If the larva of *Lestodiplosis xylodiplosuga* sp. n. traces a prey in an examined vessel, it penetrates into the vessel. Depending on the prey position it may disappeaer in the depth or even only part, at half or three quarters length and remains then in this position in total immobility for up to more than 24 hours.

Larvae of *Lestodiplosis xylodiplosuga* sp. n. search and attack only the larvae of *Xylodiplosis*. They do not attack larvae of *Lestodiplosis xylodiplosuga* sp. n. which they meet while searching for prey. Cannibalism has not been observed in this species.

Predator-prey relationships

When the larva of *Lestodiplosis xylodiplosuga* sp. n. detects and finally finds its prey, it pierces very quickly with its mouthparts in the body of its prey by thrusting the sclerotized spikes of the mandibles into the integument of the prey at any point of its body and just at this moment the prey larva stops moving. The mouthparts of *Lestodiplosis xylodiplosuga* sp. n. are not deeply fixed into the body of the prey. Some freshly attacked *Xylodiplosis*-larvae, which are moving free on the cut surface, free themselves from attacking larvae of the predator by writhing movements of the body or by means of a jump. In contrast to the *Lestodiplosis*-larvae, the *Xylodiplosis*-larvae possess the ability to jump by the contraction of body muscles.

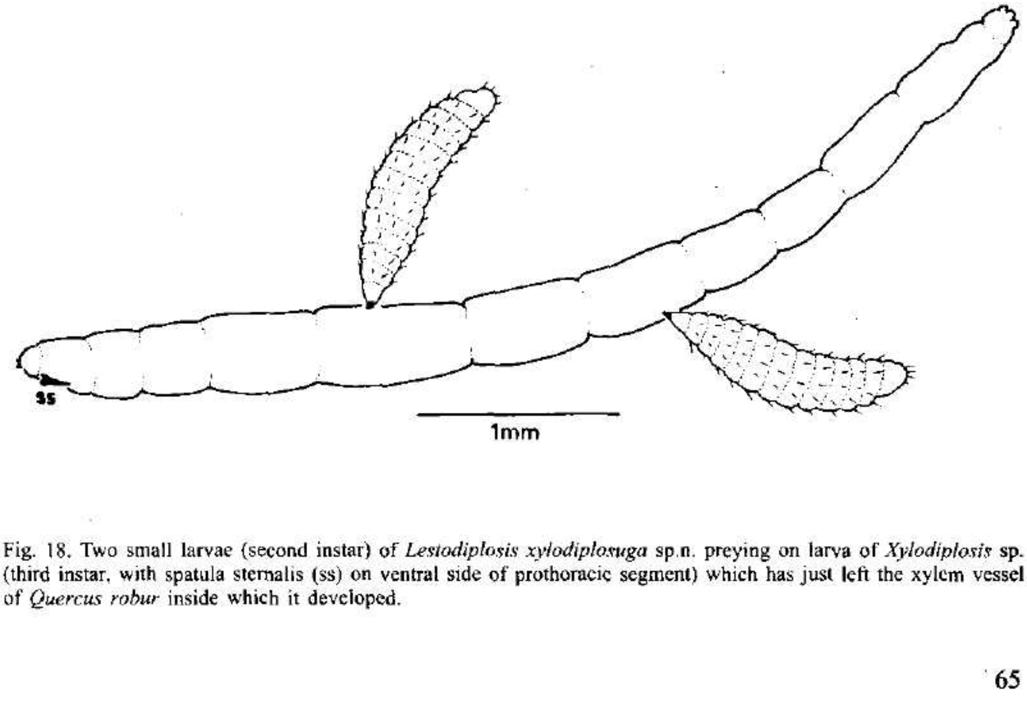


Fig. 18. Two small larvae (second instar) of *Lestodiplosis xylodiplosuga* sp.n. preying on larva of *Xylodiplosis* sp. (third instar, with spatula sternalis (ss) on ventral side of prothoracic segment) which has just left the xylem vessel of *Quercus robur* inside which it developed.

At the moment of the attack the larva of *Lestodiplosis xylodiplosuga* sp. n. injects a secretion of the salivary glands by means of the hypopharyngeal pump. The secretion induces firstly immobility and then general paralysis of the prey. The secretion includes both inhibiting and paralysing substances, probably together with digestive enzymes.

The larva of *Xylodiplosis* stops all its movements a few minutes after the attack. About 20–30 minutes after the attack it is possible to see the last signs that the larva is still alive. A hungry larva of *Lestodiplosis xylodiplosuga* sp. n. sucks its prey, the *Xylodiplosis*-larva, over several hours. During this time, the inner contents of the body of the *Xylodiplosis* larva are completely sucked out, with the exception of the larval fat body (*corpus adiposum*) which is not consumed during the sucking process. Larvae of *Lestodiplosis xylodiplosuga* sp. n. do not show any conspicuous movements externally, from time to time they move the head forward and backwards slightly, several peristaltic waves run through the larval body and the cephalopharynx inside the head capsule shows very fine vibrations. That is the outer evidence of **extraintestinal digestion.**

After several minutes of sucking, the body of the *Xylodiplosis*-larva loses turgor and starts to decrease and, on the other hand, the body of the predatory larva *Lestodiplosis xylodiplosuga* sp. n. successively increases. Larvae of *Lestodiplosis xylodiplosuga* sp. n., after several hours of sucking its prey, seem to be fully fed. They remain without any movement and seem to be apathetic for hours. In the end of the process of sucking, the larva of *Lestodiplosis xylodiplosuga* sp. n. is larger and thicker than it was at the initial phase and its prey, the larva of *Xylodiplosis*, is smaller, deformed, wrinkled, only the larval skin remains lying not far from the thick, full fed predator.

Usually only one, but occasionally two or even three larvae of *Lestodiplosis xylodiplosuga* sp. n. attack one *Xylodiplosis*-larva (Fig. 18). More than one *Lestodiplosis* larva attacks a *Xylodiplosis* larva when it is moving on the cut surface and only one *Lestodiplosis* larva attacks its prey inside xylem vessels.

At the beginning of the attack usually the prey, the *Xylodiplosis* larva (third instar), has just crept from the xylem vessel where it has developed, and its body is very long, about 5 mm, and very slender, only about 0,3 mm wide. The integument is smooth, without any setae, the head is small head with short antennae but the *spatula sternalis* on ventral side of prothorax is well developed. The body of *Xylodiplosis*-larvae is well adapted to life in very narrow xylem vessels. On the other hand, the larva of the predator, the larva of *Lestodiplosis xylodiplosuga* sp. n. (second instar), is only 1 or 1,2 mm long and 0,3 mm broad. Its body is densely covered with long setae, has a relatively large head with sclerotized mouthparts, relatively long antennae and on the ventral side has small prolegs which make it possible to move very quickly. Two large tubercles on the terminal segment of larval body serve as prop when larva search its prey hidden deeply in xylem vessels. In contrast to the larva of *Xylodiplosis*, the larva of *Lestodiplosis xylodiplosuga* sp. n. does not have a *spatula sternalis*.

Larval development

The duration of larval development of *Lestodiplosis xylodiplosuga* sp. n. in the course of one season can be evaluated only indirectly. Only data about egg-laying are available, data about the development of the embryo inside the egg (*embryogenesis)* and about the first larval stage remain unknown. In the course of the season, larvae of *Lestodiplosis xylodiplosuga* sp. n. developing in May and June take 33–35 days and in September and October they take 46–79 days. Larvae of *L. xylodiplosuga* sp. n., which do not reach the stage of full-grown larva (third instar) in the autumn, hibernate at that developmental stage directly in the wood. During the period 1997–1999, the larvae of *Lestodiplosis xylodiplosuga* sp. n. survived successfully winter periods with temperatures as low as –14 °C.

Pupation

Fully-grown, mature larvae of *Lestodiplosis xylodiplosuga* sp. n. (in the third instar) find shelter in hiding places on the bark and cracks on trunks of trees, or fall to the soil. The larvae spin cocoons in which they spend a part of their life, where they hibernate and in the end they pupate.

One fully-grown *Lestodiplosis* larva 2.2 mm long and aged 46 days, started to spin a cocoon early in the morning of the following day. Already after three hours the whole larva was covered with a thin, transparent cocoon. The process of formation of this initial cocoon lasted three hours. One female emerged from this cocoon 11 days after the beginning of the cocoon-spinning procedure.

Inside the cocoon, the larva gradually changes into a pupa. The quiescent stage preceding the pupa is the prepupa. Inside the skin of the 3rd larval stage, the pupa develops by the process of rebuilding all larval tissues. If the process of metamorphosis from the larval stage into pupal stage started shortly after spinning the cocoon, then the pupation lasted 11 days. The pupation of *Lestodiplosis xylodiplosuga* sp. n. lasted 9–15 days in July, 9–19 days in late summer and up to 32 days in autumn.

Life cycle

The life cycle involves a series of changes including the stage of egg, larva, pupa and adult gall midges, a male and female and all processes connected with these stages, as the mating, egg-laying, reception of food and water, spinning the cocoon, and involves all activity from the birth up to the death. Early two phases of the life cycle of *Lestodiplosis xylosiplosuga* sp. n., i.e. the development inside the egg and the first larval stage, are running quite secretly inside the xylem vessels. It is possible to assess the duration of these phases only indirectly.

The first part of the life cycle of *L. xylodiplosuga* sp. n., from the time when the cut surfaces on oak trunks were made and the females of *L. xylodiplosuga* sp. n. appeared for the first time up to the time when the first larvae of *L. xylodiplosuga* sp. n. of the 2nd and 3rd instars were observed searching for prey on cut surfaces, was 33–35 days, and pupation lasted 9–32 days. Based on these facts, the life cycle of one generation of *L. xylodiplosuga* sp. n. lasts minimally 42, maximally 67 days. In the course of one season two generation may develop.

Occurrence

Larvae of *Lestodiplosis xylodiplosuga* sp. n. which occur on cut surfaces or surfaces of broken branches of oak trunks are fairly rare in nature. They were found only in the forests near Rottenburg am Neckar (southern Germany) in the course of investigations with *Xylodiplosis* spp. Usually only one, occasionally two to four, exceptionally seven larvae were found on one cut surface and usually these larvae were not of the same size, belonging to various developmental stages. Such larvae probably originate from egg-laying of different females. In the course of investigations in 1997 and 1998 a total number of 31 larvae of *Lestodiplosis xylodiplosuga* sp. n. were found.

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In memoriam Marie Flasarová

RNDr Marie Flasarová, CSc, was born at Rokytnice near Přerov on February 27th, 1934. Having finished her secondary studies at Přerov, she studied at the Natural History Faculty, J. E. Purkyně University in Brno. Her major interest was systematic zoology and ecology of animals but she combined her studies with those of chemistry. She graduated from that faculty as a B. A. in both biology and education. At the same university, she took her PhD title in 1969. Then she defended her thesis to obtain the CSc degree in biological science.

The whole life style of Marie Flasarová was importantly influenced by her marriage to a similarly ardent zoologist, associate professor RNDr Ivo Flasar, CSc, a malacologist well-versed in general zoology. In 1959 a daughter, Miroslava, was born to them.

Marie Flasarová's first post was with the Regional Water Management Development Center in Teplice, the present Ohře River Drainage Area Management, in 1958–1963. There she worked as a hydrobiologist. In 1963–1972, she was the expert assistant at the Department of Natural History of the Faculty of Education in Ústí nad Labem, where she lectured in zoology. She also supervised several diploma theses, established a laboratory for her students and founded zoological collections at the Faculty. In spite of the fact that, unlike her colleagues, Flasarová had already published papers in prestigious foreign periodicals, she was dismissed from her position for political reasons. Only after five years was she given the function of a zoologist with the Regional Museum in Teplice where she worked, together with her husband, until the last days of her life. Marie Flasarová died after a short illness on January 29th, 2000, still avidly interested in the research problems in which she was engaged at that time.

From the very beginning of her scientific career, Marie Flasarová successfully devoted her attention to the invertebrate order Isopoda. In that field of science, she elaborated her diploma thesis "On the knowledge of Moravian and Silesian Oniscoidea" under the supervision of Professor Sergej Hrabě. Flasarová described two species new to science, one from eastern Slovakia and the other from North Korea. Besides, she discovered seven species new to the fauna of the then Czechoslovakia, three of which were found introduced into greenhouses. Beyond doubt, her positive development in the field of isopodology was also due to the fact that Flasarová inherited the libraries and collections of Professor Z. Frankenberger and associate profesor W. Černý who had also worked in this field of zoology. Of importance was also the fact that, together with her husband, she visited a large number of European institutions where the above topics were also studied, above all, in Germany, Poland, Russia and Hungary.

To this day Flasarová's papers devoted to the anatomy of isopod stomach have been cited in papers on isopods worldwide. Of major and fundamental importance, however, are her faunistic and ecological papers. Among these, a special place is occupied by her extensive study of the isopods in north-western Bohemia (Flasarová 1995), which served as her PhD thesis in 1991. The

Marie Flasarová published a total of 30 papers on isopods (some of them in collaboration with her husband; those papers, at the same time, tackle some of the malacological problems), six papers on vertebrates (together with her husband), and two on diplopods (by both husband and wife, together with Professor Gulička of Bratislava). Besides, she is the author of nine popular scientific articles published in magazines of nation-wide importance, and at least 60 such articles in regional press (these articles are not included in the appended bibliography; a complete list of Flasarová's publications has been published in Flasar (2000) and contains even unpublished research reports prepared, above all, for various Nature Conservation institutions).

The life's work of Marie Flasarová was greatly acknowledged by her being included among eleven most important isopodologists on the occasion of the International Symposium in Haifa, Israel (Carefoot 1998). The sudden death of this unusually diligent zoologist has unfavourably affected the completion of an extensive manuscript of a paper on the history of occurrence of fishes in the river Labe in the Czech Republic. This work was prepared in co-operation with her husband and involved a study of many hundreds of sources in various libraries and archives.

With the death of Dr. M. Flasarová, Czech zoology has lost not only an important expert in the taxonomy of the order Isopoda but even in the field of natural science research and, at the same time, an efficient populariser of zoological knowledge. With her unassuming manner and bringing contentment into every negotiation, Marie Flasarová has left behind an agreeable memory of a good human being and, thanks to her precision, also an extensive amount of valuable published data to be used by many generations of zoologists to come.

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Jan Buchar

Erratum

HÁNĚL L. 2000: Microgradient changes of soil nematodes (Nematoda) in litter and moss-lichen transects in spruce and beech forests. *Acta Soc. Zool. Bohem.* **64**: 27–36.

P. 28, L. 16:
(Rusek 1996) instead of (Rusek 1993)

P. 28, L. 21–24; P. 30, L. 1–2:
replace the text by

Several indices were calculated as follows:
– Shannon index of diversity for genera
$H'gen = -\Sigma\ f(k)\times \log_e f(k)$
– Sum Maturity index (Yeates 1994)
$\Sigma MI = \Sigma\ v(k)\times f(k)$
– *Heterogeneity Maturity Index (Háněl 1996)*
$HMI = -\Sigma\ v(k)\times f(k)\times \log_e f(k)$

P. 30; Tab. 2.
replace
ΣMI instead of MI

P. 30. Tab. 2
after the last line in the Tab. 2

HMI – H'	2.32	2.28	1.96	1.72	1.55	1.78	1.89	1.85	1.84	2.18	2.06

insert the actually last line

M/B	2.13	1.44	1.57	8.13	3.83	1.49	1.33	1.68	1.48	0.61	1.68

P. 32; Tab. 3.
replace
ΣMI instead of MI

P. 30, L. 4, 7, 9
replace MI by ΣMI

P. 31, L. 31
replace (0.06–0.17 g) by (0.06–0.17 μg) and (0.30 g) by (0.30 μg)

P. 31, L. 44
(Rusek 1996) instead of (Rusek 1993)

P. 32, L. 12
replace MI by ΣMI

P. 34, L.15, 31
replace MI by ΣMI

p. 29; replace
(see next page)

Tab. 1. Distribution of soil nematode species in samples from moss-litter transect in spruce plantation and moss/lichen litter transect in beech wood

	moss-litter										moss/lichen-litter											
	P 1	P 2	P 3	P 4	P 5	P 6	P 7	P 8	P 9	P 10	S 1	S 2	S 3	S 4	S 5	S 6	S 7	S 8	S 9	S 10	S 11	S 12
Eumonhystera filiformis (Bastian, 1865)											+						+			+	+	
Plectus acuminatus Bastian, 1865	+	+		+							+				+							
Plectus geophilus de Man, 1880	+							+	+		+											
Plectus longicaudatus Bütschli, 1873								+	+		+	+	+	+	+				+		+	
Plectus rhizophilus de Man, 1880									+	+								+				
Plectus sambesii Micoletzky, 1915	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+		+
Wilsonema schuurmansstekhoveni (De Coninck, 1931)	+	+			+	+	+	+	+	+		+	+							+		
Teratocephalus paratenuis Eroshenko, 1973		+						+	+													
Teratocephalus tirellus Anderson, 1969											+	+	+	+	+	+	+	+	+	+	+	+
Teratocephalus terrestris (Bütschli, 1873)	+	+	+		+		+	+	+	+												
Metateratocephalus crassidens (de Man, 1880)		+	+	+				+	+	+	+	+			+		+	+		+	+	+
Heterocephalobus elongatus (de Man, 1880)					+				+													
Acrobeloides nanus (de Man, 1880)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Panagrolaimus rigidus (Schneider, 1866)	+	+						+	+			+				+				+		
Panagrolaimus spondyli Körner, 1954													+	+	+	+			+			
Rhabditis terricola Dujardin, 1845											+		+		+						+	
Bunonema reticulatum Richters, 1905									+	+												
dauer larvae 1)					+	+	+	+	+	+												
Aphelenchus avenae Bastian, 1865						+																
Aphelenchoides cyrtus Paesler, 1957											+	+	+	+	+	+	+		+	+	+	+
Aphelenchoides ferrandini Meyl, 1954	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Aphelenchoides parietinus (Bastian, 1865)						+		+														
Aphelenchoides saprophilus Franklin, 1957	+	+	+	+		+	+	+	+	+												
Aphelenchoides stammeri Körner, 1954 2)	+	+	+	+	+		+		+													
Aphelenchoides Fischer, 1894 sp.	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+				+	+	+
Filenchus amaritus Zell, 1988		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Filenchus ditissimus (Brzeski, 1963)	+	+	+	+	+		+	+	+	+		+	+				+			+		
Filenchus longicaudatulus Zell, 1988	+	+		+	+	+	+		+											+	+	
Filenchus quartus (Szczygiel, 1969)	+	+	+	+	+	+	+	+		+												
Filenchus Andrássy, 1954 sp.1	+	+	+			+	+					+	+		+			+	+		+	
Filenchus Andrássy, 1954 sp.2											+	+	+	+	+	+				+	+	+
Lelenchus leptosoma (de Man, 1880)															+	+					+	
Tylenchus davainei Bastian, 1865											+	+	+	+	+							
Malenchus bryophilus (Steiner, 1914)	+	+	+	+																		
Malenchus exiguus (Massey, 1969)											+	+	+	+	+			+	+	+	+	+
Cephalenchus hexalineatus (Geraert, 1962)											+	+		+	+	+	+	+	+		+	
Ditylenchus Filipjev, 1936 sp.		+	+	+																		
Deladenus Thorne, 1941 sp.																		+				
Alaimus parvus Thorne, 1939											+		+									
Alaimus primitivus de Man, 1880	+									+												
Prismatolaimus intermedius (Bütschli, 1873)									+									+			+	
Eudorylaimus silvaticus Brzeski, 1960 3)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+
Eudorylaimus Andrássy, 1959 sp.											+											
Aporcelaimellus obtusicaudatus (Bastian, 1865)											+										+	+
Tylencholaimus mirabilis (Bütschli, 1873)											+				+	+	+				+	+

1) probably mostly infective stages of *Steinernema* Travassos, 1927; 2) systematic position of species unsettled, either placed in *Aphelenchoides* or in *Ektaphelenchus* Fuchs, 1937 (Hunt 1993); 3) in moss-litter transect probably also some individuals of *Microdorylaimus parvus* (de Man, 1880) with juvenile stages indistinguishable from *Eudorylaimus silvaticus*

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